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## TWO NEW MEMBERS OF THE GENUS *SCOLEOPTERIS*<sup>1</sup>

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### ABSTRACT

The genera of Carboniferous Marattiaceae are reviewed with special reference to *Scoleopteris*, and two new species of *Scoleopteris* are described: *S. monothrix* and *S. illinoensis*. *Scoleopteris monothrix* is unique in the long multicellular hair borne by each sporangium, while *S. illinoensis* is characterized by having five or six sporangia per synangium, small spores and conspicuous multicellular hairs on the lower surfaces of the rachis and pinnules. R. BRADLEY EWART, 228 Ridge Terrace, Park Ridge, Illinois.

### INTRODUCTION

The genus *Scoleopteris*, founded by Zenker in 1837, is based upon silicified fructifications from the Lower Permian of Saxony. To date the following species have been described:

- S. elegans* Zenker, *Linnaea* 11:509. 1837. (A more detailed description was given by Strassburger in 1874.)
- S. subelegans* Grand'Eury, *Acad. Sci. Inst. France, Mém.* 24:72-73. 1877.
- S. ripageriensis* Grand'Eury, *ibid.*, p. 73.
- S. minor* Hoskins, *Bot. Gaz.* 82:427-436. 1926.
- S. oliveri* Scott, *Journ. Linnean Soc. London, Botany*, 49:1-12. 1932, and pp. 309-321. 1933.
- S. latifolia* Graham, *Bot. Gaz.* 95:456-458. 1934. Emend Mamay, *Ann. Missouri Bot. Gard.* 37:425-428. 1950.
- S. radforthii* Andrews, *Ann. Missouri Bot. Gard.* 30:435-437. 1947.
- S. iowensis* Mamay, *Ann. Missouri Bot. Gard.* 37:429-431. 1950.
- S. minor* Hoskins, var. *parvifolia* Mamay, *ibid.*, pp. 431-432.
- S. incisifolia* Mamay, *ibid.*, pp. 433-436.
- S. major* Mamay, *ibid.*, pp. 436-439.

*Scoleopteris* is characterized by pectopterid pinnules bearing sporangia in sori on the abaxial surfaces. The sporangia composing a sorus are attached to a common pedicel, but are free above, and lack a common synangial sheath.

The following account deals with two additional species that fit these characteristics and thus have been assigned to the genus *Scoleopteris*. Further evidence for placing them in this genus will be recorded under the description of each species.

<sup>1</sup> An investigation carried out in the graduate laboratory of the Henry Shaw School of Botany of Washington University and submitted as part of a thesis in partial fulfillment of the requirements for the degree of Master of Arts.

## MATERIALS

Both species are based on fertile pinnules found in coal balls that were collected by Dr. Henry N. Andrews from a site two miles northeast of Berryville, Illinois. The outcrop lies in the upper part of the McLeansboro group of the Pennsylvanian of Illinois.

## THE CARBONIFEROUS MARATTIACEAE

Fructifications referable to the Marattiaceae are borne mostly on *Pecopteris* type foliage. They were borne on the under (abaxial) surface of the leaves, situated over a veinlet or between the veinlet tip and the margin, and unlike the living genera the majority of the fossils have radially symmetrical sori.

Mamay (1950) included the following genera in the Carboniferous Marattiaceae:

1. *Cyathotrachus* Watson, emend. Mamay: Syngangia pedicellate; sporangia enclosed in a continuous syngangial sheath; basal portion of syngangium with central column; apical portion hollow and cup-like. Based on petrifications.
2. *Ptychocarpus* Weiss: Syngangia pedicellate; sporangia enclosed in a continuous syngangial sheath, and fused to a central column extending through the entire length of the syngangium. Based mainly on compressions.
3. *Scoleopteris* Zenker: Syngangia pedicellate; sporangia attached to a central receptacle but free distally. Based mainly on petrifications.
4. *Sturiella* Weiss: Syngangia pedicellate; sporangia basally fused but free above; annulus present. Based mainly on petrifications.
5. *Acitbeca* Schimper: Syngangia sessile; sporangia attached at their bases to a central column, with distal portions free; sporangial apices long and bristle-like. Based mainly on petrifications.
6. *Asterotbeca* Presl: Syngangia sessile; sporangia attached to a receptacle, but free distally, their long axes parallel to the plane of the pinnule. Based mainly on compressions.
7. *Eoangiopteris* Mamay: Sori linear; sporangia arranged in two rows along fleshy receptacle; sori located along lateral veins; sporangia free. Monotypic. Based on petrifications.

Thus, the accepted criteria for separating the fossil genera are the following:

1. Sori linear or radial.
2. Syngangia pedicellate or sessile.
3. Sporangia free above or enclosed in a continuous syngangial sheath.
4. Central column present or absent in syngangia. (It is important whether the central column extends through the full length of the syngangium or not, as in distinguishing *Cyathotrachus* from *Ptychocarpus*.)

Since the discovery of the pteridosperms, some paleobotanists have regarded certain of the supposed marattiaceous fructifications as more correctly referable to Pteridospermae. Kidston (1925) expressed this view in finding resemblances between *Acitbeca* and *Telangium*. However, Mamay (1950) concluded that upon the basis of the sizes of fructifications and spores, the arrangement of sporangia in sori, and the superficial position of sori, this fossil group more closely resembles the living Marattiaceae than the pteridosperms.

Mamay (1950) considered the coenopterid fructification *Chorionopteris* to best fill the qualifications of a progenitor of the Marattiaceae. This evolution supposedly came about by means of a "phyletic slide" from marginal or terminal sori to superficial ones. He further proposed that those fossil genera with fused sporangia are most closely allied to the living genera *Danaea* and *Christensenia*, while those with free sporangia are most closely allied to the living genera, *Angiopteris*, *Archangiopteris*, and *Macroglossum*.

#### DESCRIPTION OF NEW SPECIES

*SCOLEOPTERIS monothrix* R. B. Ewart, sp. nov. (figs. 1-12).

This fructification is distinguished by long slender sporangia each of which terminates in a single, unbranched, multicellular hair. These were borne on pectopterid pinnules with strongly inflexed and deeply incised margins in synangia consisting of four, sometimes five, or rarely three sporangia.

One well-preserved specimen was discovered in coal ball WCB 1203. It consists of an ultimate rachis with about 15 attached pinnules. Several detached pinnules and synangia were found in the same coal ball. A second intact specimen was found in WCB 1238 along with more fragments.

Nearly all synangia were found attached to pinnules and seem to have been preserved in their natural position. The morphology of the ultimate rachis and attached pinnules may be seen in the reconstruction in text-fig. 1.

The average dimension of the pinnules and penultimate mid-rib are as follows:

Pinnule length (normal) .....	6.0 mm.
Pinnule length if unrolled .....	12.0 mm.
Pinnule width (normal) .....	2.5 mm.
Pinnule width if unrolled .....	10.5 mm.
Penultimate midrib diameter .....	0.85 mm.

The penultimate or rachis midrib (fig. 7) shows no cellular detail except for the vascular supply which consists of a U-shaped strand with the concavity adaxial. The basal part is two or three tracheids in width while the arms narrow to one tracheid. Short multicellular hairs are found on the lower side. Figure 11 (A) shows some of these hairs on the longitudinally sectioned midrib. Some of them are as long as the diameter of the midrib. Figure 7 shows that these hairs are several cells in width and are irregularly spaced in contrast to the hairs found in the sporangia.

As seen in fig. 11, the pinnules are joined laterally where attached to the rachis but become separate a short distance out from the rachis. They are of the pectopterid outline characteristic of the genus. The margins are so strongly flexed downward that they parallel and finally almost enclose the synangia as may be seen in fig. 10 (B). The pinnule is devoid of synangia along the distal third of its length and this portion is strongly flexed downward and inward toward the rachis midrib almost completely enclosing the synangia and the space directly below them. This space appears to be loosely filled with sporangial hairs which are oriented in the direction of the midrib. These hairs may be seen, mostly in transverse section, in

fig. 10 (A). The pinnule margins are deeply incised and may be compared in structure to those of *S. latifolia* and *S. incisifolia*. Figure 12 (B) shows one of the marginal lobes in vertical section. A row of these lobes in transverse section may be seen in figs. 8 and 11 (B). In fig. 8 the cellular contents of these lobes may be seen. The lobes join laterally at about the level of the sporangial apices, but their vascular strands continue as discrete bundles. The only other cellular structure of the lamina that is preserved is a layer of hypodermal cells below the upper epidermis; it is one or two cells in thickness and may be seen at the top of fig. 4 and in figs. 10, 11, and 12.

The synangia form a single row of nine or ten sori on either side of the midrib of each pinnule.

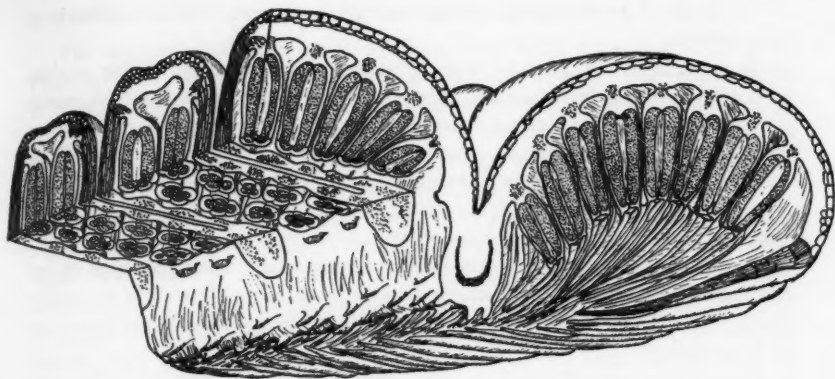
A synangium usually contains four sporangia, but those with five, such as the one in fig. 9, are also common and one has been found with three. The sporangia composing a synangium are arranged radially on a common pedicel. Due to the long slender nature of the synangia, it was not possible to find a good median longitudinal section showing both the pedicellate attachment and the apex bearing a portion of a sporangial hair. Thus, fig. 4 was prepared from three photomicrographs showing these features in their proper proportions: the upper shows the pedicellate attachment and the proximal half of two sporangia; the middle shows the distal half of two sporangia and their apices; and the third shows simply the basal portion of a hair characteristic of the species.

The sporangia are long, slender and roughly cylindrical but are slightly wider near the base than at the apex; they are tightly appressed to one another and the synangia themselves are quite crowded. The apex of each sporangium, prior to dehiscence, is curved inward toward the center of the synangium and fits closely against the apices of the other sporangia (figs. 2, 4). Thus a central synangial cavity is formed which is completely enclosed. Dehiscence was accomplished by a longitudinal slit along the inner face of the sporangium (fig. 1); in fig. 8 a mass of spores may be seen discharging through the slit.

This leads to the question of how the spores escaped from the enclosed synangial cavity. Figure 6 shows a synangium of *S. monothrix* at a later stage and is from a different specimen than that shown in most of the figures. The preservation is poor but it may be seen here that the sporangia have separated except where joined to the pedicel. This synangium, along with several empty ones, was attached to a fragment of a pinnule. In all probability the strongly curved pinnules to which these fructifications are attached straightened somewhat at maturity, decreasing the crowding of the synangia, and allowing the component sporangia to separate.

In figs. 3 and 4 it may be seen that a single, long multicellular hair is attached on the outer periphery of a sporangium near the apex. It is likely that such a hair grew on most if not all sporangia of *S. monothrix*, but no sporangium has been observed to have more than one hair. No branching has been observed in these hairs nor has any deviation in position or structure been noted. In fig. 3, the "bulb" at the distal end of the hair is merely the point at which the hair leaves the plane of the section and is not the termination of the hair; the total length is much greater than is shown. By following the course of a cluster of hairs it





Text-figure 1. Reconstruction showing abaxial view of part of a pinna of *Scoleopteris monothrix*. Portions of some pinnules are cut away to reveal arrangement of the fructifications.  $\times 9$ .

is possible to estimate their length. The hairs in such a cluster all tend to point in one direction, toward the rachis midrib. In fig. 10 (A), a cluster of hairs may be seen in transverse section in the space below the sporangia. In fig. 12, clusters of hairs may be seen on either side of and pointing toward the rachis midrib (A) where they terminate. It is almost certain that these hairs originate on the sporangia, as no trace of an attachment has been observed elsewhere. It is thus concluded that the sporangial hairs are 2 or 3 times the length of the sporangia or 4 to 6 mm. in length.

The average dimensions of a synangium are as follows:

Total length of synangium (exclusive of hairs) .....	2.0 mm.
Total length of sporangium (exclusive of hair) .....	1.8 mm.
Maximum diameter of sporangium .....	0.35 mm.
Diameter of pedicel .....	0.35 mm.

The spores as shown in fig. 5 are monolete and bilateral with a length of  $12 \mu$  and a width of  $9 \mu$ . The smooth walls appear to be thick, but lack any markings of the exine, except where obviously due to damage. The only member of the genus with smaller spores is *S. elegans* with spores  $10 \mu$  in diameter. Using the method described by Radforth (1939), the average number of spores per sporangium is estimated at 9,000.

From the above description it may appear that *S. monothrix* has some rather striking characteristics for this genus. Some thought was given to the possibility of establishing a new genus but it was decided that this would not be necessary. The following are the reasons for placing this species in the genus *Scoleopteris*:

1. It seems most appropriate to refer it to the Marattiaceae on the basis of the nonindusial sori borne on the abaxial surface of pectopterid leaves.
2. The pedicellate, radial synangia limit it to *Scoleopteris*, *Ptychocarpus*, or *Cyatbotrachus*.

3. Lack of a continuous synangial sheath and central column limit it to *Scoleopteris*.

4. It is borne on pinnules with a morphological structure similar to those of *S. latifolia* and *S. incisifolia* and is believed to be closely related to these species.

5. Although it has a closed synangial cavity at maturity, this opens at a later stage causing the synangia to assume a more scoleopterid appearance. Other members of the genus, such as *S. incisifolia*, also have closely appressed sporangia.

6. Although hairs of the *S. monobrix* type are unique for the genus, *S. major* is known to have multicellular hairs on the sporangia.

7. Although *S. monobrix* has small spores and large sporangia, they do not represent the extremes of the genus. As mentioned above, *S. elegans* has smaller spores, while *S. major* has sporangia from 0.3 mm. to 1.1 mm. longer than those of *S. monobrix*.

*Scoleopteris monobrix* may be differentiated from other members of the genus by the following characteristics:

1. No other member of the genus has a single, long, multicellular hair in a fixed position on the outer periphery of the apex of the sporangium. The synangial hairs of *S. major* are quite different.

2. *S. oliveri* and *S. incisifolia* are the only other species with bilateral spores. Of these two, only *S. incisifolia* compares to *S. monobrix* in having a smooth exine but the spores of the former are  $22 \times 14 \mu$  while those of the latter are only  $12 \times 9 \mu$ .

3. In sporangial length, *S. monobrix* is intermediate between *S. major*, which is 0.3 mm. to 1.1 mm. longer, and *S. oliveri*, which is 0.48 mm. to 0.40 mm. shorter. However, both of these species have a greater sporangial width than *S. monobrix*. The ratio of sporangial length to width is greater in *S. monobrix* than in any other member of the genus, being about 6:1.

4. The blunt connivent apices of *S. monobrix* further distinguish it from *S. major*, which has very acute apices.

The specific name *S. monobrix* is proposed in reference to the unique sporangial hairs.

*Specific diagnosis:* Synangia consisting of four, sometimes five, rarely three sporangia basally attached to a common pedicel. Sporangia 1.8 mm. in length and 0.35 mm. in width; apices blunt, connivent in synangia but separating after dehiscence; dehiscence by longitudinal clefts along inner sporangial wall. A single, unbranched, multicellular hair one cell in diameter located on the outer periphery of the apex of each sporangium, reaching a length two or three times the length of a sporangium. Pinnules averaging 6 mm. in length and 2.5 mm. in width (exclusive of inflexed margins), margins strongly inflexed and deeply incised, ultimate rachis with U-shaped vascular strand and thick multicellular hairs averaging 0.85 mm. in length. Spores monolete, averaging  $12 \mu$  long and  $9 \mu$  wide, with thick walls and smooth exines.

*Age:* McLeansboro Group, Upper Pennsylvanian.

*Locality:* Berryville, Illinois.

*Holotype slides:* Slides 2987-2995 (from WCB 1203).

*SCOLEOPTERIS illinoensis* R. B. Ewart, sp. nov. (figs. 13 and 15-26).

This description is based upon specimens from WCB 1204 and WCB 1239, particularly the latter from which the type slides were chosen. The fructifications in these coal balls were found to be in an excellent state of preservation. They were found attached to pinnules which were in turn attached to pinnae midribs. By cutting WCB 1239 in two planes, it was possible to obtain peels which revealed the morphology and something of the anatomy of the specimens.

Five or six sporangia are radially grouped on a short common pedicel to form a synangium. Of the 14 synangia seen in fig. 16, four contain six sporangia, seven contain five, while it is difficult to determine the numbers of the other three. Examination of other synangia has shown that those synangia with six sporangia are almost as numerous as those with five. As may be seen in fig. 16, the synangia form a single row on either side of the pinnule midrib. There are generally six or seven synangia per row. A vascular bundle branching from the pinnule midrib is found at the base of each synangium as seen in fig. 23 (C).

The outer sporangial walls are thick and curved as seen in fig. 16, but are composed of but one layer of cells. The lateral walls are thinner and straight, but do not touch one another, except in synangia which, like the one at the bottom left of fig. 16, contain spores and are probably less mature than the others. It is likely that the sporangia in a synangium separate as they mature, like those in *S. monothrix*. Dehiscence occurs by means of a longitudinal slit along the inner wall of each sporangium. Most of the sporangia seen in this study had already dehisced but a few may be seen to contain spores (fig. 22). The sporangia are roughly ovate in vertical section with acute apices that curve inward toward the center of the synangium as seen in fig. 23 (B). The sporangial cavity does not extend into the distal part of the apex. Figure 13 shows a transverse section through the apices of a synangium.

The average dimensions of the fructifications are as follows:

Total length of synangium .....	0.66 mm.
Total length of sporangium .....	0.65 mm.
Maximum diameter of sporangium .....	0.31 mm.
Diameter of pedicel .....	0.16 mm.

The spores are spherical in shape and have a crescent-shaped indentation in the exine at one point as indicated by the arrow in fig. 18. Examination of well preserved spores leads to the conclusion that this may be regarded as a natural and constant character. The diameter of the spores averages 15  $\mu$ .

The penultimate midrib may be seen in transverse section in fig. 23 (A). The vascular supply consists of a U-shaped line of tracheids, and extending from the free end on the right hand side is a small bundle of tracheids representing a pinnule trace just departing.

Figure 24 represents an oblique longitudinal section of the vascular supply in an ultimate pinnule. The arrow indicates a branch of this trace. Following the trace distally, it may be seen that this is one of six such branches each of which passes into the pedicel of a synangium. One of these traces may be seen in transverse section in fig. 23 (C).

The pectopterid pinnules are alternately spaced along the rachis midrib as may be seen in fig. 15. The pinnule margins are minutely toothed (fig. 17) and reflexed downward (figs. 19-22).

Following are the average dimensions of the rachis midribs and pinnules in these specimens:

Pinnule length	5.5 mm.
Pinnule width	2.2 mm.
Rachis midrib diameter	1.0 mm.

Figure 19 shows a row of pinnules, each with a pair of sori, arranged along a rachis midrib and sectioned transversely. At the extreme left is the rachis midrib in oblique section. The anatomy of the pinnules is well shown in fig. 20. The upper epidermis is not preserved, but the underlying, large hypodermal cells (A), form a layer one or two cells thick. Below this layer is a zone of palisade parenchyma (B), consisting of one or two layers of narrow, tightly-packed, elongated cells. Underlying this is the spongy parenchyma (C) of loosely-massed rounded cells, and numerous air chambers. Bounding this is the lower epidermis (D).

A notable feature of *Scolecopteris illinoensis* is the abundance of hairs on the lower surfaces of the pinnule midribs (figs. 24, 26). They are multicellular, unbranched, and one cell in diameter. Figure 21 shows that they extend beyond the apices of the sporangia. The hairs in transverse section may be seen between the two rows of synangia in fig. 16. Similar hairs have been observed attached to the synangial pedicel. In fig. 22, the arrow indicates a small outgrowth of the sporangial wall which may be the base of a hair, but these have not been seen on other sporangia.

*S. illinoensis* clearly belongs in this genus but differs from other members of the genus as follows:

1. The only other species in which it is not rare to find six sporangia in a synangium is *S. iowensis*. *S. minor* rarely has six, but a comparison of that species in fig. 14 with *S. illinoensis* shows a distinct difference in numbers of sporangia.

2. This species differs from *S. iowensis* which has spores measuring 65-80  $\mu$  in diameter, four times the diameter of those in *S. illinoensis*. *S. iowensis* sometimes has a double series of synangia on each side of the pinnule midrib, while this has not been observed in the present species.

3. Although multicellular hairs are sparingly present on the lower side of rachis and pinnules of *S. minor*, no species has hairs on the pinnules that are as conspicuous as in *S. illinoensis*.

*Specific diagnosis:* Synangia consisting of five or six sporangia basally attached to a common short pedicel. Sporangia 0.65 mm. in length and 0.31 mm. in width; apices acute and incurved; dehiscence by longitudinal cleft along the inner sporangial walls. Pinnules averaging 5.5 mm. in length and 2.2 mm. in width, with inflexed minutely toothed margins. Ultimate rachis with U-shaped vascular strand. Unbranched, multicellular hairs, one cell in diameter and reaching 0.7 mm. in length produced on pinnule midribs and synangial pedicels. Spores spherical, 15  $\mu$  in diameter with crescent-shaped mark on exines.

Age: McLeansboro Group, Upper Pennsylvanian.

Locality: Berryville, Illinois.

Holotype slides: Slides 2996-3005 (from WCB 1239).

#### SUMMARY

Two new species of *Scoleopteris* are recorded both of which were found in the Upper Pennsylvanian of Illinois. *S. monothrix* is distinguished by its long sporangia each of which has a distally attached long, multicellular hair. The tips of the component sporangia were tightly appressed when immature. The spores are very small and their number per sporangium high. *S. illinoensis* is characterized by having five or six sporangia per synangium, small spores, and conspicuous multicellular hairs on the underside of rachis and pinnules.

#### ACKNOWLEDGMENT

This study was carried out in the laboratories of Washington University under the guidance of Dr. Henry N. Andrews, to whom the writer wishes to express his sincere thanks; it is a part of a paleobotanical research program aided largely by the National Science Foundation. Thanks are also extended to Dr. Tom L. Phillips for assistance with paleobotanical techniques and for aid in other ways.

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## EXPLANATION OF PLATE

## PLATE V.

*Scolecoperis monothrix*

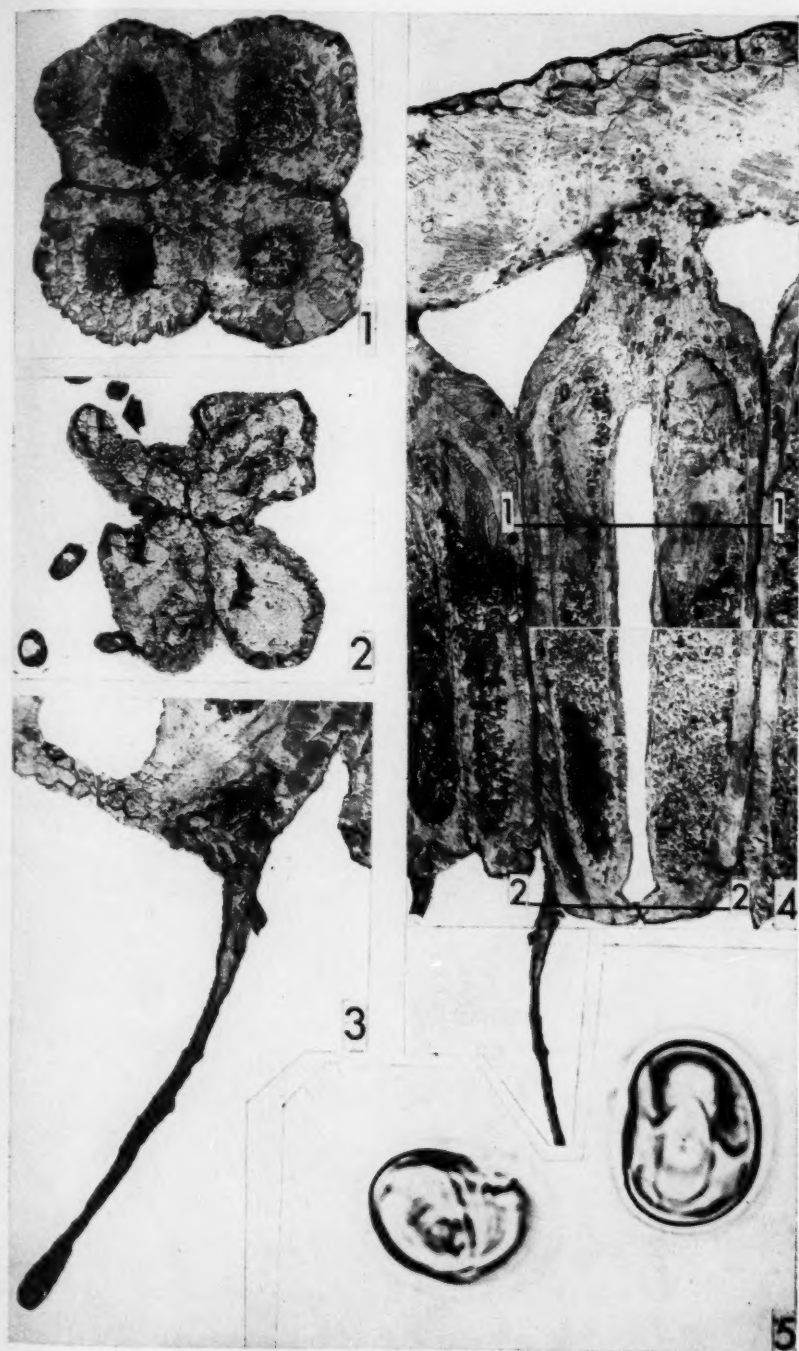
Fig. 1. Transverse section of a synangium sectioned in the plane 1-1 of fig. 4. Note spores passing into synangial cavity. Slide 2994.  $\times 85$ .

Fig. 2. Transverse section of apex of synangium sectioned in the plane 2-2 of fig. 4. Note that all four apices fit closely together. Also note the four celled base of a sporangial hair (arrow). Transverse section of several hairs from other sporangia may be seen. Slide 2994.  $\times 85$ .

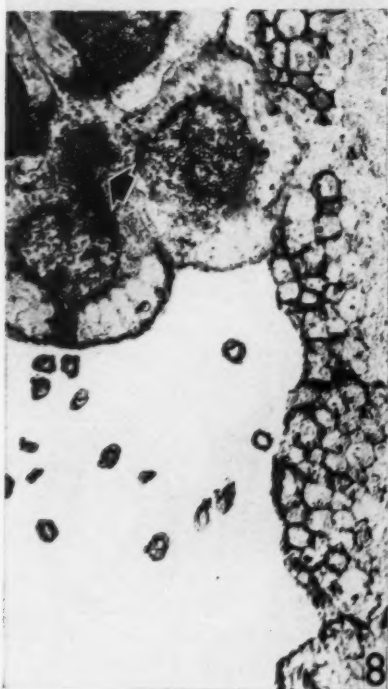
Fig. 3. Longitudinal section of sporangial apex showing hair. "Bulb" at distal end is the point at which the hair leaves the plane of the peel. Slide 2988.  $\times 100$ .

Fig. 4. Longitudinal sections of synangium and synangial hair indicating characteristic form and pedicellate attachment to the pinnule. Three separate sections from slides 2988, 2989, and 2990.  $\times 50$ .

Fig. 5. Spores. Slide 2987.  $\times 2250$ .



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## EXPLANATION OF PLATE

## PLATE VI.

*Scolecoperis monothrix*

Fig. 6. Longitudinal section of open synangium of more mature specimen. Slide 2992.  $\times 50$ .

Fig. 7. Transverse section through midrib of rachis. Note U-shaped vascular strand (arrow) and hairs. Slide 2989.  $\times 55$ .

Fig. 8. Transverse section through synangium, sporangial hairs, and inflexed pinnule margin. Note spore mass passing into synangial cavity (arrow). Slide 2994.  $\times 85$ .

Fig. 9. Transverse section of a synangium consisting of five sporangia. Slide 2994.  $\times 85$ .

## EXPLANATION OF PLATE

## PLATE VII.

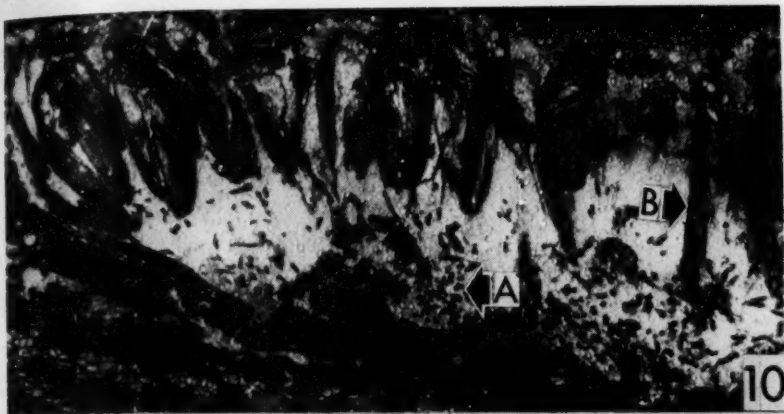
*Scolecopteris monothrix*

Fig. 10. Transverse section of pinnules in plane 10-10 of fig. 11. Note sporangial hairs (A) filling space below synangia. Slide 2995.  $\times 13$ .

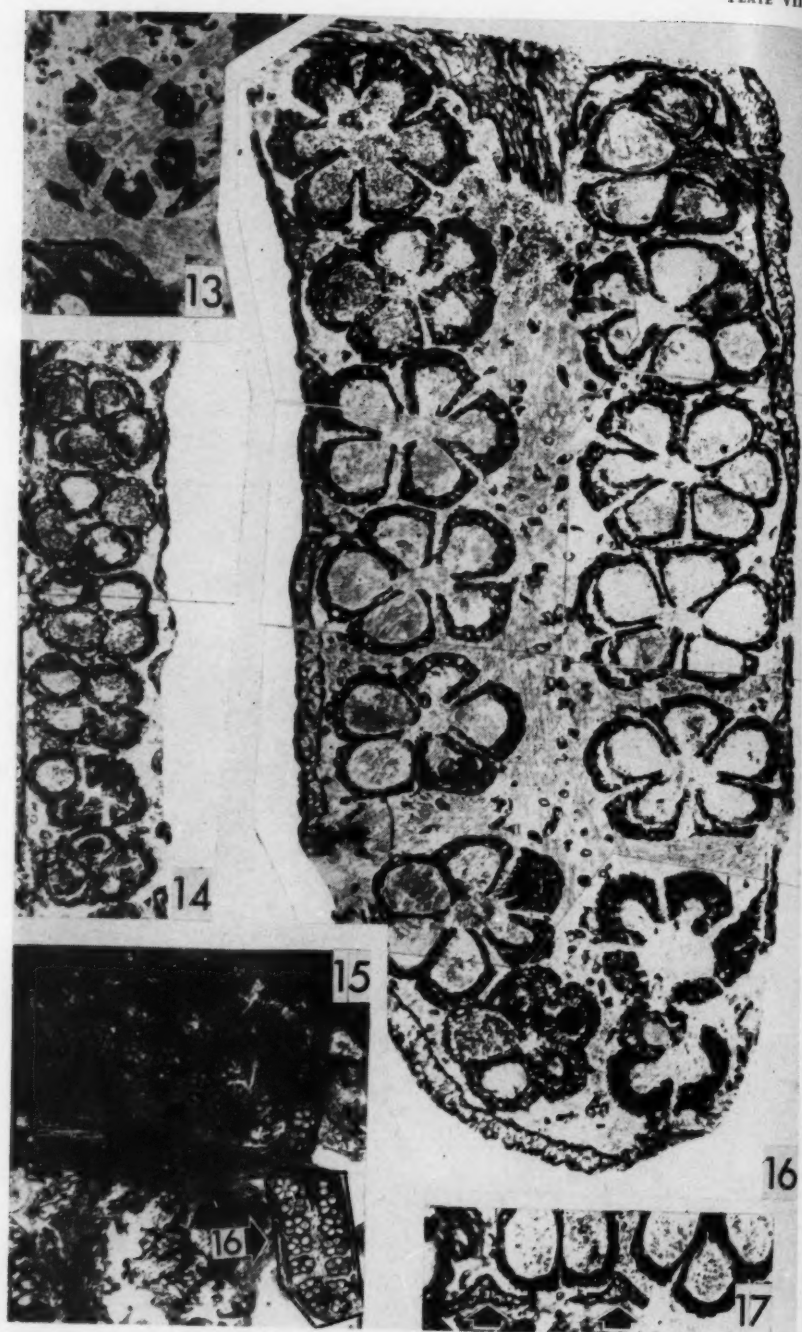
Fig. 11. Section of pinnules in plane of lamina. Note hairs on rachis midrib (A) and transverse section of pinnule margins (B). Slide 2993.  $\times 15$ .

Fig. 12. Section at right angle to rachis midrib in plane 12-12 of fig. 11. Note rachis midrib (A) and strongly inflexed pinnule margin (B). Slide 2991.  $\times 12$ .





EWART—TWO NEW MEMBERS OF SCOLEOPTERIS



EWART—TWO NEW MEMBERS OF SCOLEOPTERIS

## EXPLANATION OF PLATE

## PLATE VIII.

Figs. 13, 15-17. *Scolecopteris illinoensis*Fig. 14. *S. minor* Hoskins

Fig. 13. Transverse section of a synangium in the region near the apex. Slide 3004.  $\times 35$ .

Fig. 14. Transverse section of a row of synangia. Compare with *S. illinoensis* in fig. 16. Slide 3004.  $\times 30$ .

Fig. 15. Longitudinal section of rachis midrib with attached fertile pinnules. Slide 3005.  $\times 5$ .

Fig. 16. Single pinnule from fig. 15 enlarged. Note hairs in transverse section between rows of synangia. Slide 3004.  $\times 35$ .

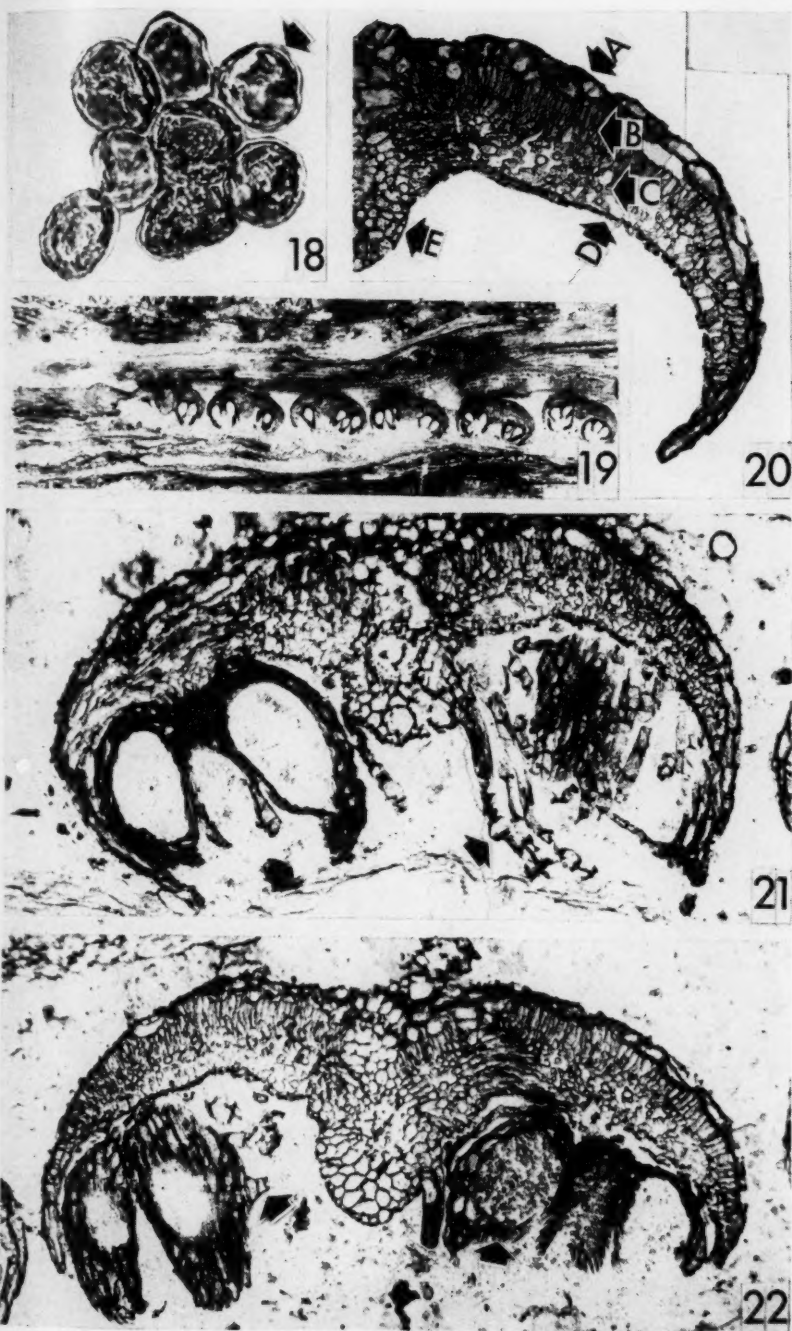
Fig. 17. Section through pinnule margin showing toothed nature of the margin (arrows). Slide 2998.  $\times 35$ .

## EXPLANATION OF PLATE

## PLATE IX.

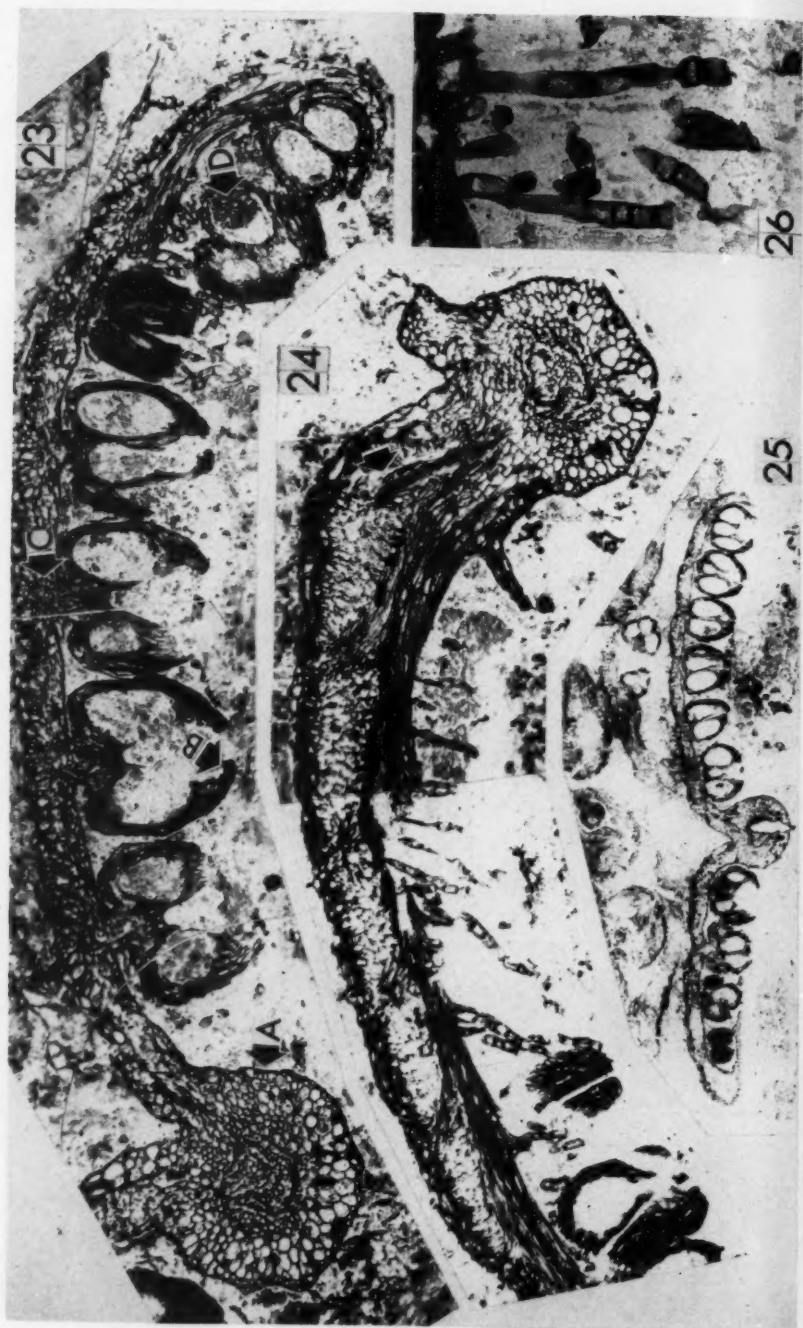
*Scolecopteris illinoensis*

- Fig. 18. Spores. Note crescent-shaped mark on exine. Slide 2996.  $\times 1033$ .
- Fig. 19. Obliquely transverse section of fertile pinnules. Note rachis midrib at extreme left. Slide 3003.  $\times 6$ .
- Fig. 20. Transverse section of half of a pinnule showing anatomical detail. A. Hypodermal cells (upper epidermis is poorly preserved); B. Palisade parenchyma; C. Spongy parenchyma; D. Lower epidermis; E. Pinnule midrib. Slide 3000.  $\times 62$ .
- Fig. 21. Transverse section of a fertile pinnule. Note long hairs on midrib. Slide 3001.  $\times 57$ .
- Fig. 22. Transverse section of a fertile pinnule. Note hair on sporangium and sporangium with spore mass. Slide 3001.  $\times 57$ .



EWART—TWO NEW MEMBERS OF SCOLEOPTERIS





EWART—TWO NEW MEMBERS OF SCOLEOPTERIS

## EXPLANATION OF PLATE

## PLATE X.

*Scolecopteris illinoensis*

Fig. 23. Longitudinal section of fertile part of pinnule. A. Transverse section of pinna midrib. B. Incurved apex of sporangium. C. Vascular bundle at base of synangial pedicel. D. Spore mass in sporangium. Slide 2997.  $\times 33$ .

Fig. 24. Longitudinal section of pinnule midrib. Note vascular strands branching from midrib and hairs on midrib. Slide 2997.  $\times 33$ .

Fig. 25. Section showing pinna midrib with pinnules on either side. Slide 3003.  $\times 11$ .

Fig. 26. Hairs on pinnule midrib. Slide 2999.  $\times 90$ .

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# PORTRAITS OF PLANTS. A LIMITED STUDY OF THE "ICONES"<sup>1,2</sup>

ERNA RICE EISENDRATH

## ABSTRACT

A set of four criteria for defining the word "icones" is established: that the illustrations be full page in size; that they include some portrayal of the habit of growth of the plant; that they be botanically accurate; that they give aesthetic satisfaction. Each of the "icones" must fulfill each requirement in some degree, except in the plant portrayals of the 16th and 17th century herbals. The history of these cuts is traced throughout their oft-repeated use, and their exception to the general rule discussed in the light of their great botanical importance.

Four genera of the Cucurbitaceae (*Fevillea*, *Cucurbita*, *Lagenaria*, *Luffa*) are chosen as limiting factors in the study, and illustrations of these plants available in the library of the Missouri Botanical Garden discussed in relation to the criteria previously set up. The study is concluded with a chronological index of "icones" of these key species. ERNA RICE EISENDRATH, Henry Shaw School of Botany, Washington University, St. Louis 30, Missouri.

## BOTANICAL USE OF THE WORD "ICONES"

The word "icones" was taken into botanical parlance by Otto Brunfels in 1530. Its spelling in the title of his *Herbarum vivae eicones* still conveys a hint of orientalism just strong enough to tie in with its common meaning today; to the layman, an icon is (as it was, to the publishers of Webster's *New International Dictionary* of 1918) "a religious image in the Eastern church". For botanists, however, it is not the gilt on these distorted saints that glows when they speak reverently of "icones". Their enthusiasm is evoked by a kind of floral illustration which they automatically lump as "icones" in special sections of libraries; to which they readily refer as "icones" in conversation; of which they will confidently name names as true "icones"; but for which they hesitate to pronounce a definition. So, though everybody knows the special meaning of the word, there remains the problem of establishing criteria by which to implement its definition; a later problem will be to list the books containing illustrations that satisfy the criteria.

To start from an authoritative beginning I give you Benjamin Daydon Jackson, who in 1900 first published in London his most useful *Glossary of Botanic Terms*. To him, "icones"<sup>3</sup> are merely "pictorial representations of plants; botanic figures". In this sense which includes all botanical illustrations it was certainly used by Pritzel<sup>4</sup> in his *Iconum Botanicarum* of 1855 and is also so used in the Latin title page of the *Index Londinensis*.

For the purposes of this paper, however, I prefer basing my criteria on the last word of the last definition of "icon" given in the *Oxford English Dictionary* (Oxford, 1933): "esp. applied to 'figures' of animals, plants, etc. in books of Natural History. Obs." The use of "icon" to include all natural history illustrations is now obsolete; when botanists speak today of the "icones" it is with a

<sup>1</sup> An investigation carried out in the graduate laboratory of the Henry Shaw School of Botany of Washington University and submitted as part of a thesis in partial fulfillment of the requirements for the degree of Master of Arts.

<sup>2</sup> The author wishes to express her gratitude for their help in preparing this manuscript to Dr. Edgar Anderson, Dr. Hugh Cutler and Dr. George Van Schaack.

<sup>3</sup> Jackson's definition is given for the plural form more commonly used by botanists than the singular.

<sup>4</sup> "The task which Pritzel set himself in the preparation of his *Index* was to record in the simplest way all 'valuable' figures of Phanerogams and Ferns, excluding, with certain exceptions, those of the pre-Linnean period." (O. Stapf, Hon. Editor of the *Index Londinensis*, in Introduction to the 1929 edition.)

different connotation, not specifically stated in any source that I can find. It implies more than scientifically accurate illustrations, and more than attractive plant portrayal, falling some place between the two and partaking of both but, with a kind of hybrid vigor, better than either. Dr. Hugh Cutler bravely ventured to make the following brief but telling statement. "The 'icones'," he said, "may have nothing to do with the church exactly, but a great many botanists worship them." That is, apparently, about as far as educated angels dare to tread; this fool will now step in to define "icones" by establishing the criteria which distinguish them from other illustrations in botanical books.

#### CRITERIA DISTINGUISHING "ICONES"

After examining every lead to illustrations of the key<sup>5</sup> genera of Cucurbitaceae available at the Missouri Botanical Garden library (some 157 volumes), I have set up four arbitrary criteria for "icones". The first is that the illustrations be full page<sup>6</sup> in size; the second, that they include portrayal of the habit of growth of the plant. The third is botanical accuracy, and the fourth artistic presentation.

In many instances my first criterion is necessitated in order to eliminate illustrations used simply as elaborations of a text. According to Nissen (1951), "the documental botanical illustration should, for the co-investigator, replace the plant itself, be he distant in time or place".<sup>7</sup> So, too, must true "icones" be visual portraits of plants, dependent in no sense upon the written word. P. J. F. Turpin, the great French botanical artist, quite naturally believed that the brush was greater than the pen as a naturalist's tool, and wrote that he "who possesses only the latter loses perhaps the more significant" (Turpin, 1820). But the brush used to depict the plant must do so in considerable detail, and the portrait must be extremely accurate—so accurate as to compete with the botanist's dried herbarium specimen as a source material for study. (The possibility of this is recognized in the official acceptance, though rare, of such representations as type specimens.) Small figures of plants cannot possibly fulfill all of these requirements; hence the first criterion for true "icones": that they be full page illustrations.

My second criterion for defining true "icones" is that they represent the habit of plants, and include both vegetative and reproductive organs. It is possible to object that this is unnecessary, since one can assume that generic characters are "given", and that only identifying specific characters need be depicted in plant portraiture. This objection I liken to a statement that a man's fingerprints identify him; certainly they will differentiate him from all other men, as certain characters of a species of plants will also differentiate it. Neither fingerprints nor selected characters, however, will give us portraits of the individual or the species, and, in defining today's usage of the word "icones", I insist that portrait is the proper synonym (if any is truly proper).

"Icones", then, must portray habit of growth, and here is another example of the need to pin a word to exact definition. What is "habit"? Webster (*New*

<sup>5</sup> See p. 296.

<sup>6</sup> For many 16th and 17th century herbals this criterion must be ignored for reasons explained later in the text.

<sup>7</sup> Translated by Mr. Alfred Sadler.



*Intern. Dict.*, 1918) gives as its eighth definition of the word, "*Nat. Hist.* Characteristic form or mode of occurrence or growth; as, elms have a spreading *habit*." Jackson, deriving "habit" from the Latin, gives, "The general appearance of a plant, whether erect, prostrate, climbing, etc." Sir Joseph Dalton Hooker, the great systematist, Director of Kew Gardens, and editor of volumes 91–130 of Curtis' *Botanical Magazine*, wrote, "Habit of a plant, of a species, a genus, etc., consists of such general characters as strike the eye at first sight, such as size, colour, ramification, arrangement of the leaves, inflorescence, etc., and are chiefly derived from the organs of vegetation" (Hooker, 1875–97). To this I append the requirement that either flower or fruit must be depicted; however, it is not always easy to decide where "habit" is illustrated and where it is not.

I have, for instance, not listed among the "icones" pertinent plates (see plate XI) in Tournefort's *Institutiones rei herbariae* (1700), even though they are cited by Linnaeus (*Species Plantarum*, Stockholm, 1753, vol. 2, pp. 1010–1011) in his original description of the genus *Cucurbita*. My reasons are that Aubriet illustrated for Tournefort only parts of plants—fruits (and with dissections, too!), seeds, flowers, peduncles, etc., but no idea of the appearance of the plant itself is given. Again, L. H. Bailey, in his *Garden of Gourds* (1937), includes page after page of drawings, almost all of which show sections of the stem, flowers, fruits and leaves. Since they also show tendrils where tendrils exist, it is apparent that such plants would climb if given a chance to do so, and I have therefore listed a number of these illustrations among the "icones"; but I have eliminated such as that of the "Mock Orange" variety of *Cucurbita Pepo*, which depicts a pistillate flower, a fruit with peduncle attached, a tendril, a stem in cross-section, and enlarged dissections of the style and stigma, as well as of the anther column; but habit, no!—so it is not listed.

In this connection it is interesting to note that only the earliest "icones" illustrate the root. This is undoubtedly a loss to plant portrayal, and probably came about when interest in plants shifted to a taxonomic basis from the pragmatic approach of the rhizotomists and their followers. These predecessors of the herbalists performed magic and cures based on lore often dating from the Greek period, and generally associated, in popular folk ritual, with properties inherent in plant roots (Singer, 1928). Also worth noting is the rarity of portrayal of habitat along with habit. This is so important a factor in the systematics of botany, and was used so wonderfully by Audubon in his portrayals of birds and animals, that one wishes it were more often used as backdrop to "icones" of our flora. Nissen's (1951) statement, "Plant sociology . . . is of recent date, and representation of it is prepared more and more with the camera,"<sup>8</sup> very possibly explains this lack.

If the portrait of a plant belongs at all within the field of botany, it must be scientifically accurate, my third criterion for "icones". The degree of precise detail will vary in each plant portrait, as it does in human portraiture. There is, however, a most important difference in the requirements of the two. A portrait of a man shows all the artist can tell us about a single individual, be he godlike or sickly earthling; but, to quote from Arber (1938), "the drawing which is ideal from the standpoint of systematic botany, avoids the accidental peculiarities of any indi-

<sup>8</sup> Translated by Mr. Alfred Sadler.

vidual specimen, seeking rather to portray the characters fully typical for the species." This distinction is well illustrated in the very book that introduced the word we are trying to define, Brunfels' *Herbarum vivae eicones*: here we find that some of Weiditz' magnificent "living portraits" exhibit such "accidental peculiarities", probably as a result of an overly enthusiastic return to direct observation from nature. Note figure 1, of Weiditz' *Arctium lappa* L., in which the plant's poor wilted leaves add nothing except the information that it had been pulled from the earth too long before Weiditz got around to drawing it. He apparently did not itch, as Tournefort felt the true botanical artist should, to get his observations on to paper. "It frets a man", Tournefort wrote (quoted from Blunt, 1951) "to see fine Objects and not be able to take Draughts of them; for without this help of Drawing, 'tis impossible any account thereof would be perfectly intelligible." The requirements of accurate botanical illustration are that the characters of a species be accurately represented; fortuitous accident in the life story of the individual, such as its being attacked by voracious insects, is of no interest to anything or anybody but the insect and the plant.

It is almost pedantic to add that accuracy is not impaired by the additional quality of aesthetic satisfaction, the fourth of my criteria. Among the "icones" the two are found in variable proportions, the balance being struck not only on the basis of the purpose for which the pictures were made, but also depending upon the date of their publication. The demands of fashion in taste and interest can be followed clearly throughout the centuries. Many flower illustrations of great decorative quality have no botanical value whatsoever, and quite correctly end their usefulness as lamp shades; this kind of work reached its nadir in the 19th century, when spinster ladies sentimentally painted charming bouquets on china, as well as any other available surface. When these illustrations appeared in books, they were usually accompanied by saccharine verse, under such titles as *The Moral of Flowers* (Marquand, 1947).<sup>9</sup> Today's floral illustrations represent the opposite extreme. We tend to file scientific data in compartments well isolated from all aesthetic consideration; for this reason we must beware of eyeing with suspicion the accuracy of figures that are pleasing. It is important to remember, as is subsequently discussed, that the "icones" include the work of Turpin, Fitch and many other extremely gifted artists, whose talents were exhibited in a field that demanded far more of them than simple art for art's sake.

An aesthetic quality, then, is the last of four criteria set up for true "icones"; full page illustration, portrayal of habit and botanical accuracy have all been discussed above. Extremely few illustrations will pass all these tests; but who

<sup>9</sup> The sentimental (or should I say romantic?) approach cannot be limited entirely, however, to spinster ladies or to the 19th century. Linnaeus himself effused most colorfully: "The petals of the flower contribute nothing to generation but serve only as bridal beds, gloriously arranged by the great Creator, who has adorned them with such noble bed-curtains and perfumed them with so many sweet perfumes that the bridegroom may celebrate his nuptials with all the greater solemnity. When the bed is thus prepared, it is time for the bridegroom to embrace his beloved bride and surrender his gifts to her." And Erasmus Darwin, grandfather of Charles, versified,

"With honey'd lips enamoured woodbines meet,  
Clasp with fond arms, and mix their kisses sweet."

(Both quotes are from Krutch, Joseph Wood, *The Gardener's World*, New York, 1959; p. 24.)



Figure 1. "De lappis" (*Arctium lappa*), vol. II. p. 62, *Herbarum rive icones*, Otto von Brunfels, Argentoreti, 1531.

knows better than a botanist that taxa must be elastic, and that no set of characters is invariably true for all the units that the taxon must include!

"Icones" may be found in regional floras, de luxe tomes concerned only with the plants growing in a single garden, learned treatises on classification, serials published by scientific institutions or nurserymen's catalogues. All of these fall within the enormous body of illustrated botanical literature, of which the *Index Londinensis* lists well over 3000 titles, and for the purposes of this paper it was necessary to establish a limited approach. One could set up chronological barriers, choosing, as did Sitwell and Blunt (1956), two centuries as a high point in botanical illustration. One could profitably discuss only the work of one great artist, such as Turpin, whose name appears several times on these pages. One could trace any of several aspects of the subject through the pages of Curtis' *Botanical Magazine* during its almost two hundred years of publication. Or, one can approach this loose aggregate of illustrated books with a particular subject as the tool by which to cut it down to workable proportions. This method has been used, with four genera of the Cucurbitaceae the limiting factor.

#### KEY SPECIES OF THE CUCURBITACEAE AS LIMITING FACTORS IN THIS STUDY

Various reasons may be cited for pursuing the study of "icones" through illustrations of members of the Cucurbitaceae. As is later discussed, the family is generally distinguished by a fleshy fruit, a structure known as a "pepo"; but, whereas in many plant groups the fruits may be used to delimit various taxa, it cannot be said of the cucurbits that "by their fruits ye shall know them". There are "pepos" and "pepos", and the close relatives, among many cultivated forms, will produce offspring which exhibit tremendous differences. In size alone, the "pepo" may be as small, let us say, as a tangerine, or absolutely enormous, as witness the Hubbard squash or the long-as-a-man-is-tall *Lagenaria*. It is never possible conveniently to mount (and seldom even to preserve) such fruits as herbarium material; therefore, since it is for the edible, decorative and useable fruits that the family is cultivated, illustrations of them are of great botanical importance.

The flowers, too, present a problem in survival. Though they may be showy, they collapse dismally after one day of glory in the sun, a sad truism for the taxonomist, since they present most interesting morphological variations. (It may be due to the same truism that the work of many of the best known floral artists does not appear among "icones" of the Cucurbitaceae; an illustrator who attempts to draw them painstakingly from life will find that their lives are too brief to enable him to create the illusion of prolonging them!) The choice of the key genera was made for several reasons: *Fevillea* because it is the primitive group in the family, serving as starting point for a number of phylogenetic series; *Cucurbita*, *Lagenaria* and *Luffa* because their distribution is so wide and varied as to insure their appearance in a variety of publications.

The Cucurbitaceae include about one hundred genera (fide Lawrence, 1951). Not only the placement of the family in a natural system, but also the delimitation of generic characters have intrigued and baffled botanists over the years. This problem is, however, entirely beyond the scope of my study.

The Cucurbitaceae are generally tropical plants, with some species hardy enough to extend into the temperate zones. All, however, are frost-tender herbs, and survive to fruit in chilly climates only because they grow very rapidly. *Cucurbita* is native to the American tropics, and *Luffa* (with the exception of *L. operculata*, also New World) to the Old World tropics, whence *Lagenaria* probably also came, but this genus has been for a very long time universally distributed throughout the warm parts of the world.

The same three genera are of interestingly varied economic importance. *Cucurbita* is cultivated for its edible and decorative fruits, the pumpkins and squashes which traditionally are staples of the American diet, and archeologically are known to have been important long before the advent of the white man to either American continent. *Luffa*'s fruit has a fibrous interior when mature which, dried, becomes the "vegetable sponge" so widely used by masseurs; the young fruits (apparently less abrasive!) are edible. *Lagenaria* fruits in an incredible variety of forms; wherever it is grown, it teases the imagination to put the fruits to use as ladles, vases, pitchers, bird houses or merely decorations. A visitor to Georgia and Florida at the turn of the century (Odell, 1904-05) found that "hardly a domestic operation there is complete without the aid of the Gourd in some form". It was even used as a cradle for negro babies!

*Fevillea* (tropical American) is neither widespread nor economic, but is included because it is not cultivated, which fact, along with its many primitive characters, presents interesting botanical contrasts to the other genera. In *Fevillea*, for instance, the corolla is distinctly polypetalous, as it is also in *Lagenaria*. In *Luffa* it is deeply lobed; in *Cucurbita* the five petals are joined in a floral tube. Again, in *Fevillea* five stamens with biloculate anthers of an unspecialized type stand perfectly free, alternating in position with the petals; in *Luffa*, as in the other three genera, there are usually basically only three stamens (because of the coherence by their filaments of two pairs of the original five), but they are borne free on the calyx tube. In *Lagenaria* the anthers of the stamens cohere lightly, but are not truly connate; in *Cucurbita* the filaments are connate (except that sometimes they are free at the very base) and the anthers are twisted so inextricably together in a column as to be almost indistinguishable. In none of the last three genera are the anthers primitively biloculate; they dehisce by a single longitudinal split.

Of the books listed below, the following contain "icones" of *Fevillea*: Marcgrave-Piso, Plumier, *The Botanical Magazine*, *Dictionnaire des Sciences Naturelles*, Descourtilz, Martius, Velloso, Engler and Rendle. Of these, all but the serial, the dictionary and the systematists concern plants of the Caribbean and South America, the earliest of them being Marcgrave's first edition in 1648.

*Lagenaria* is illustrated, among the books listed below, by Fuchs, Dodoens, L'Obel, Dalechamps, Tabernaemontanus, Gerarde, Parkinson, Bauhin, Rheede, Rumpf, Oskamp-Zorn, Descourtilz, Velloso, Linuma, Duthie and Fuller, Bettfreund and Bailey, indicating an early European knowledge of the plant, as well as its wide spread in tropical areas of the world.

*Luffa*, rather strangely, is not pictured by those earlier herbalists who illustrated



*Lagenaria*, though both genera are thought to have originated in the Old World tropics. Among the "icones" listed we find *Luffa* first in Vesling, illustrating Egyptian plants in 1638. It appears next in Commelin, illustrating the plants cultivated in the Physic Garden of Amsterdam in 1706; later, it is pictured by Rheede, Rumpf, Cavanilles, *The Botanical Magazine*, Velloso, Martius, Wight, Iinuma, Blanco, Duthie and Fuller, Lecomte, Engler and Bailey. This indicates a wide distribution indeed, although the plant was apparently not cultivated in Europe as early as was *Lagenaria*.

Of the four genera considered in this study, *Cucurbita* is not only the best known and most widely cultivated today, but archeologically it is of great interest, being found in diggings where it can be used to trace the agriculture of early man in the so-called New World. Because of its tremendously variable fruits, seeds and other organs, *Cucurbita* also challenges the systematist and intrigues the geneticist; because its floral parts are large, it is useful to morphologists and physiologists and, because the cucurbits are easily grown, their large fruits can be retained for study, while their indeterminate growth permits flowering from maturity to frost. As a matter of fact, *Cucurbita* presents satisfying study material for most botanical specialists, though geneticists, pleased with the large pollen mother-cells, find difficulties in their miniscule chromosomes (Whitaker and Bohn, 1950). However, it is probably because of its edible and decorative fruits that we find among the "icones" more illustrations of *Cucurbita* than of the other three genera selected.

The earliest "icones" of *Cucurbita*, the two appearing in the fabulous folio edition of Fuchs, 1542, are probably also the most beautiful. We find *Cucurbita* next in the 1552 Aztec herbal known as the *Badianus Manuscript*; and at short intervals from then on, mostly in pictures derived more or less from Fuchs, cucurbits appear in Matthioli, Dodoens, L'Obel, Dalechamps, Tabernaemontanus, Gerarde, Parkinson and Bauhin. Original figures are found in Rheede, Rumpf, Buch'oz, Schkuhr, Vietz, Descourtilz, Chaumeton, Wright, Iinuma, Blanco, Duthie and Fuller, Bettfreund and Bailey. The list evidences a rapid and wide spread of knowledge about and interest in the plants.

#### EARLIEST ILLUSTRATIONS OF KEY SPECIES

None of the titles in the list of "icones" of the selected genera predates 1542, the year of publication of Fuchs' *De historia stirpium*. This fact is significant because the historical background to a discussion of plant illustration is strangely poor. Though all of man's existence (along with that of other animals!) must of necessity have been ultimately dependent upon the flora of his world, relatively very few early examples of plant delineation are known, in comparison to those of fauna. Among the key genera, the earliest I find are chance reprints in modern books, all of *Lagenaria*. The first is printed by Behling (1957), and is taken from the manuscript *Tacuinum Sanitatis* in the Austrian National Library. It is described as a page from the

"Hausbuch der Cerutti, of upper-Italian origin, from the turn of the 14th to the 15th century. . . . One sees the flask-shaped gourd (*Cucurbita lagenaria*, L.) in an excellent example, hanging in a thicket of leaves. The text below declares . . . that the gourd is cold and moist . . . and most useful to be eaten fresh and green. It stops thirst."



The second reproduction is Arber's plate iii (1938). This is from Konrad von Megenberg's *Das Buch der Natur*, Augsburg, 1475, which contains the first printed plant illustrations. It shows, in the center of a group of plants, an unmistakable *Lagenaria* fruit, pendulous on a terminal branch, the whole plant arising from a basal rosette of heart-shaped leaves. The third is in a 1940 facsimile of an Aztec herbal of 1552 (Codex Barberini, Latin 241, in the Vatican Library). Familiarly known, from the name of its translator, as the *Badianus Manuscript*, it was put together by Martin de la Cruz, described in the text as an "Indian physician . . . who is not theoretically learned, but is taught only by experience" (Arber, 1938). The colored illustration shows a *Cucurbita foetidissima*, so identified as the leaves and root seem to belong to a perennial plant. In the herbal it is called the "Ayonel-huatl", translated as "calabash root", and is described as an ingredient of a complex concoction recommended to relieve the pain of childbirth.

#### FUCHS' DE HISTORIA STIRPIUM

Fuchs' beautiful *De historia stirpium* was published in Basle in 1542, twelve years after Brunfels introduced "icones" as a botanical word. Like Brunfels', Fuchs' book is illustrated with portraits of plants made by artists who had actually looked at them. This statement does not seem startling, but it has great significance. Plant illustration in the herbals, prior to Brunfels and Fuchs, consisted of constantly recopied figures, derived from ancient originals, which in each reproduction lost more of their freshness and validity. Strangely, the invention (circa 1450) of movable-type printing, with its tremendous impact on the dissemination of all kinds of knowledge, did not immediately influence publishers to have their artists take a fresh look at plants. And this, despite the fact that illuminated manuscripts of the period often include charmingly naturalistic flower paintings, and that such artists as the Van Eycks, Van der Goes, Jacopo Bellini and Botticelli painted flowers beautifully even before a magnificent high of superb flower portrayal was reached in the work of Leonardo<sup>10</sup> (1452-1519) and Dürer (1471-1528).

Brunfels and Fuchs let fresh air into the musty chambers of illustration of the herbals, Fuchs leaving for us fine woodcuts of both *Cucurbita* and *Lagenaria*; but it is from them (see below) that subsequent generations of herbalists were satisfied to derive their illustrations, thus slamming down the window once again.

Fuchs shared with Brunfels the realization of the importance of drawing plants from life, but his artists, unlike Weiditz, (whose "living portraits", you will remember, were sometimes limited portrayals of individual plants) also understood the necessity of depicting plants typical of a species. From his own statement we know that Fuchs worked closely with the artists.

"Each (picture) . . .", he wrote in his preface, "is positively delineated according to the features and likeness of the living plants; we have taken peculiar care that they should be most perfect, and, moreover, we have devoted the greatest diligence to secure that every plant should be depicted with its own roots, stalks, leaves, flowers, seeds and fruits. Furthermore we have purposely and deliberately avoided the obliteration of the natural form of the plants by

<sup>10</sup> Leonardo wrote, "The painter will produce pictures of little merit if he takes the work of others as his standard; but if he will apply himself to learn from the objects of nature he will produce good results." (Quoted from MacCurdy, Edward, *The Notebooks of Leonardo da Vinci*, New York, 1954; p. 902.)

shadows, and other less necessary things, by which the delineators sometimes try to win artistic glory." (Quoted from Arber, 1938.)

Fuchs was himself a physician, famed throughout Europe for his successful treatment of an epidemic disease that hit Germany in 1529, but his love of plants was more than a professional interest. Again in his preface, he wrote,

"There is no one who does not know that there is nothing in this Life pleasanter and more delightful than to wander over woods, mountains, plains, garlanded and adorned with flower-lets and plants of various sorts and most elegant to boot, and to gaze intently upon them. But it increases that pleasure and delight not a little, if there be added an acquaintance with the virtues and powers of these same plants." (Quoted from Arber, 1938.)

Fuchs' great work represents the high point of the Renaissance herbal (Singer, 1928); the text has the botanical limitations of all herbals, but the illustrations are superb. The figures, fitted gracefully into the frame of the full folio page, do not thereby lose their naturalism. The lack of shading that Fuchs mentions sometimes makes the outlines appear thin, but this is much relieved by the presence of color, which the artists probably intended should be applied by hand, after printing (Blunt, 1951).

The large folio plates of the key genera include two of *Cucurbita Pepo*, called by Fuchs "Cucumis Turcicus" and "Cucumer Marinus", and three of *Lagenaria vulgaris*, labeled respectively "Cucurbita Maior", "Cucurbita Minor" and "Cucurbita Oblonga".

In 1545 an octavo edition of Fuchs appeared which contained the same illustrations of the plants under discussion, with exactly the same names given them, but in very much reduced size and mirror images of the larger cuts.<sup>11</sup> They were to have a long life indeed.

These small-scale cuts from Fuchs, along with some from other sources, were used for over a hundred years by subsequent generations of herbalists. It would take a contortionist to squeeze these overused or derived plant illustrations into the criteria set up for "icones"; but I feel they must nonetheless be included in this study, and I claim justification from the excellent authority of Dr. William Trelease, first director of the Missouri Botanical Garden. Dr. Trelease wrote,

"No study of the cultivated plants of the present time can be at all complete unless the minute and painstaking records of the herbalists are consulted, for, with so mutable a class of plants as our flowers, vegetables, farm crops and fruits, the tracing of their history under cultivation is no small part of their study. What is asserted of cultivated plants . . . is also true, though to a less degree, of the native plants . . ." (Trelease, 1896).

We shall see that a number of the plant figures of the herbalists are far from "painstaking records", but we shall also see that others which my definition would carry me by with the merest swish of the skirt, play important roles in Linnaean classification.

<sup>11</sup> Illustrations can be mechanically changed in size by use of a pantograph. This instrument, constructed of four bars, has a pencil placed at the juncture of two of them, another at the tip of a third. As a system of levers, the pantograph can be so adjusted that while one pencil traces a picture, the second reproduces it in the desired different scale. The new picture can then be pasted to an uncut block, traced thereon and a new cut made. As we shall see, the new cut often prints a mirror image of the original, because of the way the new picture is glued onto the block. (I am indebted for much of this information to Finan, John J., *Maize in the Great Herbals*, Ann. Missouri Bot. Gard., 1948; 35:8-186.)

With Fuchs' "icones" well in mind, we now embark upon an unbelievably complex task, tracing from his and other true portraits of plants the often inadequate thumb-nail sketches used and reused by successive herbalists.

#### WOODCUTS DERIVED FROM ONE SOURCE AND USED BY SEVERAL AUTHORS

Bailey (1929) identified Fuchs' "*Cucumis Turcicus*" as "undoubtedly a *Cucurbita Pepo* of the vegetable marrow kind", and Whitaker (1947) agrees. In 1563, in his *Cruydeboek*, Dodoens reproduced the smaller cut as "*Pepones magni*", using it again in 1616, in his *Stirpium historiae pemptades*, as "*Pepo maior oblongus*". In 1587, in his *Historia generalis plantarum*, Dalechamps, possibly using the same cut, called it "*Cucurbita Indica longa*", and in 1636 Gerarde, in *The herball*, described it as "*Pepo maximus oblongus*". The picture ends its career, as far as I know, as "*Cucurbita foliis asperis sive Zucha, flore luteo, Ic. II*" in Johannes Bauhin's *Historia plantarum* of 1650. This last derivative from a magnificent original has been cut down to diminutive measurements ( $8\frac{1}{2} \times 4\frac{1}{2}$  cms.); the tendrils of the plant are so stylized as to be almost indistinguishable organs, the character of the peduncle at the point of attachment is entirely lost, and the illustration becomes as far removed as possible from a portrait of a living plant.

This series presents a good example, however, of the botanical significance of many of the small derived wood-cut figures of the herbals. Linnaeus in his definition of *Cucurbita* (*Species plantarum*, 1753, vol. II, p. 1010) cited a variety  $\beta$  with Caspar Bauhin's *Pinax* as reference. Caspar, the son of John, did not illustrate his book, but referred to the pictures mentioned above, from Dodoens' work of 1616 and Gerarde's 1636 *Herball*, so Linnaeus' description is indirectly descended from a picture which may be described as a foster child of Fuchs'.

Again, Fuchs' "*Cucumer marinus*" had a long and mostly unhappy history (see Figures 2, 3 and 4). Matthioli (*Commentarii in libros sex Pedacii Dioscoridis de materia medica*) in 1558 printed as "*Zucche Indiane*" and in 1560 as "*Cucurbita Indica*" a plate which is certainly not a direct copy of Fuchs', but which almost as certainly was copied from his. Dalechamps in 1587 used Matthioli's cut, in mirror image, as "*Cucurbita Indica rotunda*", and Linnaeus (*Species plantarum*, 1753, vol. II, p. 1010) cites Dalechamps as a reference for his *Cucurbita Pepo*. Bailey (1929) says of this cut that it represents

"a tendril-bearing plant; and the fruit stems are long, apparently ridged and not enlarged next to the fruit; the leaf shape also answers well for the species we know as *Cucurbita Pepo*. The hairiness along the stem is undoubtedly exaggerated; and the leaf-bearing to the roots is conventionalized as well as the mode of fruiting."

In 1563 Dodoens printed a cut more exactly derived from Fuchs' octavo "*Cucumer marinus*", calling it "*Pepones rotundi*", and in 1616 Dodoens reused it, this time as "*Pepo rotundus minor*". By 1636, when Gerarde called it "*Pepo minor sylvestris*", the detail was considerably coarsened, but it is very possible that the same plate was used. In 1650 Bauhin printed another poor, small, derivative cut, this one "*Cucurbita foliis asperis sive Zucha flore luteo, Ic. V.*"

Fuchs' illustrations of *Lagenaria*, too, produced a motly swarm of progeny. His "*Cucurbita oblonga*" is in Dodoens, 1563, as "*Cucurbita anguina*", and in Bauhin, 1650, as "*Cucurbita longa, folio molli, flore albo*". Fuchs' "*Cucurbita maior*"

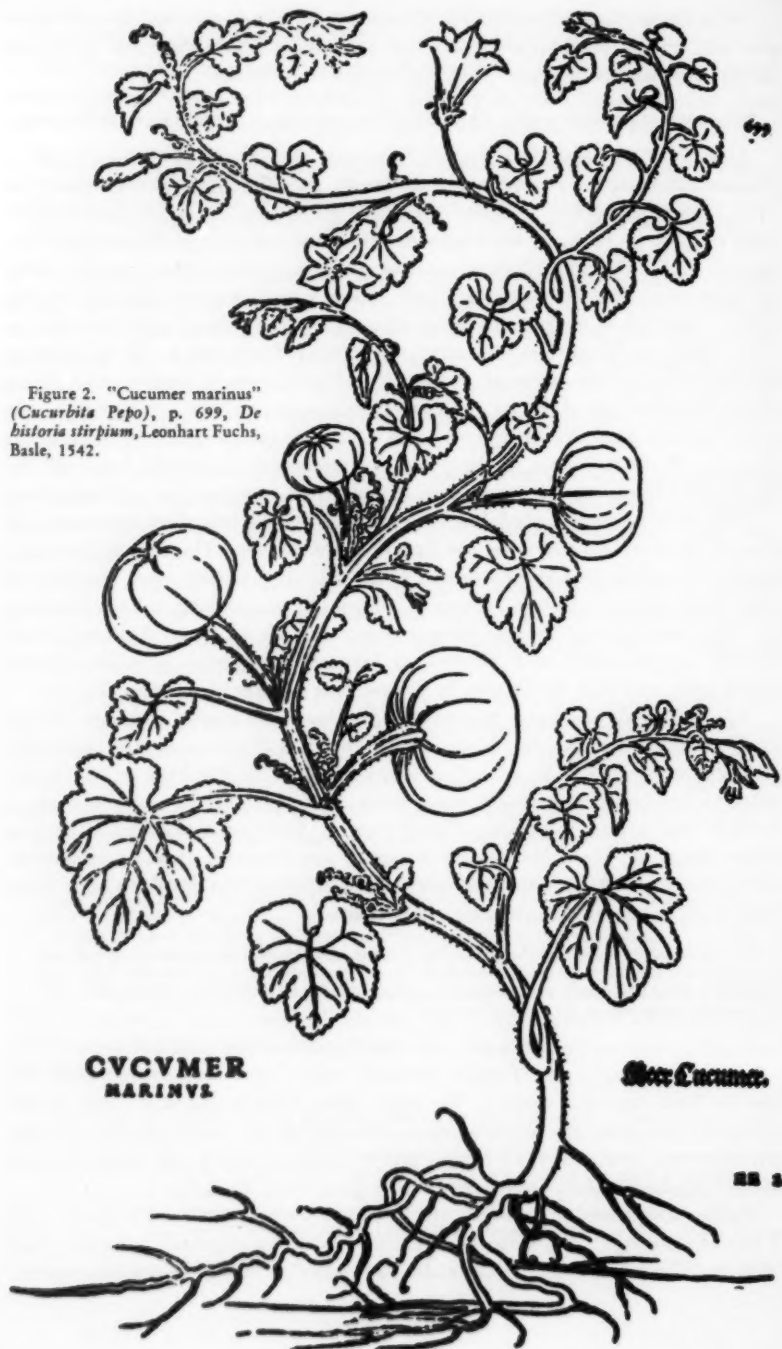


Figure 2. "Cucumer marinus"  
(*Cucurbita Pepo*), p. 699, *De  
historia stirpium*, Leonhart Fuchs,  
Basle, 1542.

**Pepones rotundi. Ronde Pepoenen.**

Figure 3. "Pepones rotundi"  
(*Cucurbita Pepo*), p. 508, *Cruy-  
deborck*, Rembert Dodoens, Ant-  
werp, 1563.

**Pepones lati.****Brede Pepoenen.**



reappears in Dodoens in 1563 as "*Cucurbita cameraria maior*", which Dalechamps also called it in 1587. (His plate, however, is a reverse of Dodoens', with slightly different measurements.) Gerarde (1636) seems to have used Dodoens' block, calling it "*Cucurbita lagenaria*", and in 1650 Bauhin brings it to a small, inglorious end, again, as "*Cucurbita latior folio molli, flore albo*". Fuchs' third and last *Lagenaria* was called "*Cucurbita minor*", and Dodoens (1563) called it by the same name. In 1587 it became "*Cucurbita cameraria minor*" in Dalechamps, and in 1650 "*Cucurbita lagenaria*" in Bauhin. Obviously, there was some confusion in nomenclature! All of the Dodoens illustrations are approximately the same size as the cuts of Fuchs' 1545 edition, and possibly from the same blocks. Dalechamps' cuts are slightly smaller and all but the "*Cucumer marinus*" derivative in reverse of the above, so he cannot have used the originals; Gerarde's print is clearer than Dodoens', but may be from the same cuts. The cuts used by Bauhin are all smaller and far coarser than any of the others.

However, not all the wood cuts used in the herbals of the period after Fuchs derive from him. A cut called "*Pepones lati*" in 1563 and "*Pepo latus*" in 1616 by Dodoens is used again by Gerarde in 1636 as "*Pepo Indicus angulosus*", and identified by Whitaker (1947) as "*C. Pepo*", possibly var. *White Bush Scallop*". Again, Dalechamps in 1587 published a charming decorative print of "*Cucurbita verrucosa*" with a good deal of fine, accurate detail, identified by Whitaker as "evidently a warted variety of *C. Pepo*". The same material, cut down in size, in mirror image, with far less grace and detail, was published by Bauhin (1650) as "*Cucurbita verrucosa*" and cited by Linnaeus, in 1753, in *Species plantarum* in his definition of "*Cucurbita verrucosa*". (But Linnaeus added, in later editions, that the plant bore marked resemblances, in flowers and seeds especially, to *C. Pepo*.) This is another example of the enormous botanical value of even such a coarse, much-worried hand-me-down as Bauhin's figure, especially as, according to Bailey (1929) the Linnaean herbarium contains no specimen named "*Cucurbita verrucosa*" by Linnaeus.<sup>12</sup>

In 1576 (*Plantarum seu stirpium historia*) and 1591 (*Icones stirpium*) L'Obel published as "*Pepo maximus Indicus compressus*" a cut identified by Whitaker (1947) as the first illustration of *Cucurbita maxima*. In 1587 Dalechamps used the picture in mirror image, as "*Pepo maximus Indicus*, L'Obel"; his cut measures 12 × 7 cms., a bit smaller than the one used by L'Obel, by Dodoens as "*Pepo rotundus maior*" in 1616, and again in 1636 by Gerarde, as "*Pepo maximus compressus*". This cut (referred to L'Obel) is cited by Lamarck in his *Encyclopédie*, ii, 151 (1786). Bauhin is also cited by Lamarck, for his portrait of "*Cucurbita aspera, folio non fisso, fructu maximo, albo sessili*".

In 1591 Tabernaemontanus published in his *Neuw Kreuterbuch* as "*Pepo Indicus minor angulosus*" a cut used by Gerarde in 1597 as "*Pepo Indicus angulosus*". The print is poor in Gerarde, but the detail in the cut is excellent and is identified by Whitaker (1947) as "probably *C. Pepo*, var. 'Table Queen'". As before, Bauhin has a mirror image of the same cut, in smaller size, and names it as

<sup>12</sup> In section 1151 of his *Catalogue of the Linnaean Herbarium*, London, 1945, Spencer Savage lists five specimens of the genus, but none is labeled *Cucurbita verrucosa*.



did Tabernaemontanus. The cut is unusual among those of the period in that it does not show a root.

The same authors use another cut, originally described by Tabernaemontanus as "*Pepo Indicus minor clypeatus*" and by Gerarde (1597) as "*Pepo Indicus fungi-formis*". Again Bauhin's use of it is in mirror image on a smaller scale; he calls it "*Cucurbita clypeiformis cortice molli et ramosa*" and Bailey (1929) says it is "undoubtedly one of the forms of *Cucurbita Pepo* var. *Melopepo*" although tendrils are a conspicuous part of this figure, and Bailey himself (1954) describes var. *Melopepo* as "Plant covering small space, compact, not running or tendril-bearing". However, this last, negative character is not cited by all authorities.

Again, Tabernaemontanus' "*Cucurbita capitata*" appears in Gerarde (1597 and 1636) as "*Cucurbita sylvestris fungi-formis*" and in Bauhin (smaller and reversed) as "*Cucurbita capitata Tabernomontani sive clypeiformis*". This, which bears no tendrils, Bailey (1929) again identifies as *Cucurbita Pepo* var. *Melopepo*.

Tabernaemontanus' "*Melopepo clypeatus*" becomes "*Pepo maximus clypeatus*" in Gerarde (1597) and (diminished in size and reversed in image) "*Cucurbita clypeiformis, sive Siciliana Melopepon latus a nonnullis vocata*" in Bauhin. This cut is again without roots; it does, however, show exceptionally good detail of flower and fruit structure and is without tendrils. It is particularly important as it represents another definite citation by Linnaeus in his description of *Cucurbita*, this time "*C. Melopepo*". Bailey (1929) says "the plant is undoubtedly what we know as Bush Scallop squash".

Bauhin used Tabernaemontanus' "*Cucurbita longa*" as his "*Pepo Indicus minor, Tabern.*" and Gerarde in 1597 used Tabernaemontanus' "*Melopepo compressus*" as his "*Pepo maximus compressus*"; Tabernaemontanus' "*Melopepoteres*" as his "*Pepo maximus rotundus*"; and Tabernaemontanus' "*Pepo maximus oblongus*", as (for once not complicating the problem) "*Pepo maximus oblongus*".

Gerarde, in 1636, had access to cuts used by L'Obel in 1576 and 1591. L'Obel's "*Pepo oblongus vulgatissimus*" (1576) became "*Pepo oblongus*" in 1591, but



## ICON V.

Figure 4. "*Cucurbita foliis asperis sive Zucha flore luteo*" (*Cucurbita Pepo*), vol. II, p. 219, Ic. V, *Historia plantarum universalis*, Johannes Bauhin, Yverdon, 1650-51.

Gerarde called it "Pepo maior sylvestris". L'Obel's "Pepo rotundus compressus Melonis effigie" retains its name in both his editions, but Gerarde calls it "Pepo Indicus minor rotundus", and Parkinson (*Theatrum botanicum*) in a very coarse 1640 reprint, "Melo Indicus parvus".

The last of the cuts of *Cucurbita*, in Bauhin, makes a very poor print indeed, and must, like the others, have been cut down from another wood block, although I have not found it printed elsewhere. However, it is another important, though indirect, Linnaean reference. Bauhin called it "*Cucurbita foliis asperis sive Zucha flore luteo*, Ic. I." Linnaeus refers in his *Hortus Cliffortianus*<sup>13</sup> and his *Hortus Upsaliensis* to Ray's *Historia plantarum*<sup>14</sup> which in turn refers to this cut in Bauhin. Bailey (1929) says, "This figure is again *C. Pepo* as we know it".

Gerarde in 1597 used three cuts of *Lagenaria* which had been used previously by Tabernaemontanus. The latter author's "*Cucurbita Indica minor*" became "*Cucurbita anguina*" in Gerarde; his "*Cucurbita lagenaria minor*", "*Cucurbita lagenaria sylvestris*". In 1636 Gerarde used cuts as "*Cucurbita anguina*" and "*Cucurbita lagenaria sylvestris*" which had also been used before and were to be used again. L'Obel (1576 and 1591) had used the first as "*Cucurbita sive Zucha omnium maxima anguina*" and Dodoens as "*Cucurbita longior*". Parkinson apparently used the same plate, in 1640, as "*Cucurbita longa*." L'Obel also in both his editions used the second of these as, simply, "*Cucurbita lagenaria*" and Dodoens as "*Cucurbita prior*". Again, Parkinson apparently used the same plate, this time as "*Cucurbita lagenaria maior*".

The constant and confusing repetition of these figures is largely due to "pools" of botanical cuts made by the publishers of botanical books. Of these the best known is Christopher Plantin, the great printer of Antwerp. Plantin's firm continued publishing for three hundred years, his place of business becoming a museum in 1876, when it was purchased by the city of Antwerp from the eighth generation of the family Moretus, direct descendants of Plantin's son-in-law, who was also his chief assistant.

Plantin published L'Obel's work as well as the later writing of Dodoens. These two men, along with Charles de L'Ecluse (who apparently used no cuts of the key genera) were friends who worked so closely together that it is not possible to tell which or who was originally responsible for material or figures in their publications.

In 1576 Plantin published *Plantarum seu stirpium icones* using L'Obel's name although many of the cuts had also been used to illustrate the herbals of Dodoens and de L'Ecluse. It is thought that it was this selection of woodcuts which Johnson bought to use in his editions of Gerarde's herbal in 1633 and 1636 (Arber, 1938). Arber (1938) believes this to be the last time the Plantin collection of blocks was used.

Jacques Dalechamps, whose *Historia generalis plantarum* appeared at Lyons in

<sup>13</sup> "Monoecia syngenesia Cucurbita-g. pl. 738 2. C. seminum margine integro tumido Pepo vulgaris-Raj. hist. 639." (*Hortus Cliffortianus*, Amsterdam, 1737; p. 452.)

<sup>14</sup> "Cap. II. De Pepone. 1. Pepo vulgaris. Cucurbita foliis asperis sive Zucha flore luteo J. B. . . . The common Pumpion, called by the vulgar, The Melon." (Ray, John, *Historia plantarum*, London, 1686-1704; p. 639.)

1587, and Jakob Tabernaemontanus, whose *Neuw Kreuterbuch* was published in Frankfurt a few years later, both seem somehow to have had access to the Plantin "pool" of cuts, as is evident from the above tracing of relationships to the same figures found in Dodoens and L'Obel; or they used, as did so many others, the octavo blocks from Fuchs' 1545 edition. Arber (1938) says that Tabernaemontanus made a collection of blocks for himself, and that they were acquired from him by John Norton to be used in his 1597 edition (the first) of Gerarde's *Herball*. According to Bartlett (1949) this was based upon a translation of Dodoens' second herbal, begun by a Dr. Priest; Gerarde took over the work for Norton, the publisher, after the death of Dr. Priest, so the material is hardly original. Gerarde is particularly remembered as a horticulturalist, having supervised the care of several famous English gardens and having himself cultivated for twenty years a fine garden of his own in Holborn.

Although John Parkinson also had a famous London garden, and was known as "Herbarist to Charles I", the examples of illustrations of my key genera found in his *Theatrum botanicum* leave much to be desired.

#### OTHER WOODCUTS IN HERBALS OF SIXTEENTH AND SEVENTEENTH CENTURIES

The search for "icones" of the key genera takes us now to Padua, where in 1638, appeared a little book on the plants of Egypt. The woodcuts of *Luffa* used by Vesling (*De Plantis Aegyptiis*, 1638) are highly stylized and poorly printed, and are not included as illustrations in Alpino's original (1592) edition of the book to which Vesling is supposedly only adding "observationes et notae". However, Sims, who edited the 1814 volume of the *Botanical Magazine*, thought rather highly of Vesling's cut. "Professor Cavanilles", Sims wrote in connection with Plate 1638, "supposes that 'Momordica Luffa' of Linnaeus may probably belong to the same genus (*Luffa*). Indeed these two plants appear to be extremely similar, as we judge from the excellent figures of Veslingius [sic], in his observations on Prosper Alpino".

Most of the seventeenth century botanical books, however, differ from Vesling in that they reflect the stimulus which all the natural sciences received from the discovery of the New World. The earliest of these that falls within the limits of this paper appeared in Amsterdam in 1648, the *Historia Naturalis Brasiliae*. The author of the section entitled *Historia Rerum Naturalium* was Georg Marcgrave, who had accompanied a Dutch expedition which conquered Brazil and took it briefly from the Portuguese. According to Wm. Swainson (1834), "Marcgrave's work abounds with a vastness of new and original information, very different from what was to be found in the crude and verbose compilations of this period." He has left for us a small wood-cut of *Fevillea*, and several other cuts which are apparently of members of the Cucurbitaceae, but are too crude and rough to be recognizable. The cut of *Fevillea* most certainly does not fit my definition of "icones", but like those of many of the herbalists it has value because of the time and place it was made. The same cut is found again in Piso's *De Indiae utriusque*, Amsterdam, 1658, actually the second edition of the volume listed above. The work of Marcgrave and Piso is so inextricably entangled that it is impossible to

know who is responsible for what. The editor of the 1648 edition gave credit to both (after Marcgrave's death), but Piso took all the credit for the second edition unto himself. The credit for the illustrations, however, is of dubious value, as Nissen (1951) writes, in his inimitable Teutonic verbosity, that "the cuts are in no way suitable to verify a doubt-free determination of a specific object".

#### ENGRAVINGS

The decadence into which the botanical woodcut sank after reaching a high in Fuchs' herbal has been traced through a devious history; with the introduction of metal plate incision comes another breath of good fresh air. This introduction presents a second of the strange anachronisms in the history of botanical illustration, comparable to the generally poor plant portrayals in the printed herbals during a period when beautiful flower paintings were being made.

The technique of engraving on metal stems from the great goldsmith tradition of the artisans and was translated to the graphic arts sufficiently early to have reached a high point in the works of Martin Schoengauer, 1445-91. However, the earliest strictly botanical book containing illustrations printed from metal plates did not appear until a century after Schoengauer's death (Van Schaack, 1959). This was Fabius Columna's *Phytobasanos*; it contained no pictures of my selected Cucurbitaceae, nor have I found such pictures in books printed until a hundred years later still. This fact, however, gives a falsely exaggerated impression of delayed adaptation of the new technique to botanical illustration. After the publication of Columna's etchings, the makers of botanical prints finally recognized that the incision of metal plates permits a far more delicate line than does wood-cutting, and the genus flourished through the seventeenth century.

Between 1678 and 1703 appeared the 12 folio volumes of *Hortus indicus malabaricus*, copiously illustrated with double page copper engravings, by Heinrich Adrian van Rheede tot Draakestein, and containing "icones" of *Cucurbita moschata*, *Lagenaria vulgaris* (see plate XIV), *Luffa acutangula* and *L. cylindrica*. Malabar lies on the west coast of southern India, and Rheede was governor of the province. Blunt (1951) feels that the author may himself have had a part in making the drawings of plants, though the plates were engraved by an Italian monk, Father Mathieu. The illustrations are sometimes of immature plants and sometimes (like those of Weiditz) picture in close detail the flaws of individual specimens, but their large size and strong calligraphic quality give them a vitality which many other plant illustrations lack. This is one of the best known of the pre-Linnean botanical books which reflect the stimulus of the introduction into Europe of new plants found during voyages of exploration or scientific inquiry. The works of Commelin, Rumpf and Plumier (see below) fit into this same category, Rheede, Commelin and Rumpf particularly pointing up, as Blunt (1951) reminds us, "the interest shown by the Dutch in the flora of their colonial possessions."

Commelin's book, *Horti medici Amstelædamensis*, concerns the rare and exotic plants in this Physic Garden, with illustrations drawn from life. These include a *Luffa operculata*, typical of the stiff engravings taken from paintings by Johan

and Maria Moninckx, to which originals Blunt (1951) claims that justice is not done. Caspar Commelin, the author, was a professor of botany and the nephew of Jan Commelin, who had been director of the Physic Garden.

The next illustrations of the key genera appear in the 6 volumes of Georg Eberhard Rumpf's *Herbarium Amboinense* published, again in Amsterdam, between 1741 and 1750. The story of the author's life is a series of mishaps so catastrophic that one can only wonder that his work was ever published. Rumpf became an employee of the Dutch East India Company in 1652, and settled at Amboina<sup>15</sup> where he indulged his love of nature until he died in 1702. However, fire, shipwreck and blindness all tested Rumpf's patience and courage, so that one cringes from criticism of the illustrations of *Cucurbita* (*C. Pepo* and *C. moschata*), *Lagenaria* and *Luffa* (*L. acutangula* and *L. cylindrica*) in his book. Let me only say that their quality is extremely variable, due to the fact that Rumpf's drawings from which his descriptions were made, were burned and he became blind before he could make more. Hence several people, including his son, made the new set, in many of which the botanical detail is poor. However, the books remain important because later authors have used his descriptions and figures as the types of many binomials of plants of the Malay flora (Merrill, 1917).

*Plantarum americanarum* listed hereafter as containing "icones" was published in Amsterdam between 1755 and 1760, and was edited by Burmann, a well-known professor of botany in that city. Burmann's "last labor" (*General Biographical Dictionary*, 1813) was to procure "engravings to be executed for the drawings of American plants left by Plumier, to which he added descriptions". Plumier, a member of a French religious order, had been sent to explore the French settlements in the West Indies, and succeeded so well that he was subsequently appointed botanist to the king (*General Biographical Dictionary*, 1813). He published many of his drawings in Paris in 1693, but these did not include the *Fevilleas* that give him entrée to the list. His plant figures were drawn to large scale in bare, cold outline, and have little artistic merit; but they were often referred to by Linnaeus, who had access to a set of copies at the University of Groningen (Sitwell and Blunt, 1956).

The next book (*Histoire universelle du regne végétal* by Pierre Joseph Buch'oz, 1775-80) containing an illustration (*Cucurbita Pepo*) that falls within the limits of this paper is the work of a botanical artist of mixed repute. Buch'oz' works are listed by Sitwell and Blunt, by Dunthorne and in most of the catalogues of exhibits of fine flower books, but the opinion in which he was held by contemporary botanists needs no elaboration beyond the specific epithet "foetida" which L'Héritier applied to a plant of the genus *Buchozia*. Nissen (1951) quotes Pritzel in a brief statement which shows no evidence of Buch'oz' reputation having soared posthumously. "Miserimus compiler", Pritzel called him, "fraude ac ignorantia aequae emineus". Pierre Joseph Buch'oz is credited with having written on all branches of natural science though understanding none, and with compiling some 300 volumes though remaining undistinguished himself! But his illustrations are very attractive indeed and Blunt (1951) grants him a few kind words because he intro-

<sup>15</sup> Amboina is one of the Moluccas in Indonesia.



duced into floral illustration "the decorative qualities which we always associate with Far Eastern art".

Antonio José Cavanilles is quite something else again. Of great botanical interest, his 6 volume *Icones et descriptiones plantarum*, concerning the plants that grew in Spain, either "spontaneously or cultivated in gardens", during his time, contain rather stiff engravings with no oriental charm whatsoever. These books were published at Madrid between 1791 and 1801, and among them is a clean cut of a *Luffa acutangula*.

The engravings of Rhee, Rumpf, Plumier, Buch'oz and Cavanilles were all printed and published in fine, folio volumes, representing "the apogee of the art of botanical illustration, reached in the 18th century" (Mongan, 1952). Next on my list is a group of smaller volumes, all published as handbooks to medical, economic or systematic botany.

#### THE INFLUENCE OF THE LINNAEAN SYSTEM

Christian Schkuhr published at Wittenberg, in 1791, 6 octavo volumes of his *Botanisches Handbuch*, the last 3 volumes consisting of an atlas of colored (in the Missouri Bot. Gard. copy) engravings. Nobody but Nissen and I seem to consider him worth mentioning, but I find the engravings both charming and carefully done, and Nissen gives Schkuhr credit for both the drawings and the plates.

Schkuhr's *Handbuch*, post-Linnean, is the first of my list to exemplify the new spirit which entered the study of botany after the publication of the *Species Plantarum* in 1753. Linnaeus' binomial system stimulated revision of older means of plant description and classification, and "called for a new and different type of illustration which emphasized scientific accuracy in the delineation of flower, fruit, leaf and stalk" (Dunthorne, 1938). The wealth of diagnostic detail included in Schkuhr's plate of *Cucurbita Pepo* is an excellent example of this new and different type, and also illustrates Dunthorne's point that "the new scientific artists first appeared in Germany". The particular care taken in dissections of the androecium and gynoecium were of course important, because Linnaeus'<sup>16</sup> sexual system was based on the number of parts included in each of these floral organs.

Mr. Nissen and I are joined by Sitwell and Blunt, and Dunthorne in listing the next entry, Johannes Zorn's *Icones Plantarum Medicinalium*, which also appears in Dutch translation by Dheoderich Leonard Oskamp as *Afbeelding in der Artsenye-gewassen*. The colored engravings of *Lagenaria* are identical in the two editions, and are quite charming.

The next series chronologically on my list is mentioned by Nissen and Sitwell

<sup>16</sup> Linnaeus' sexual system was introduced in his *Systema Naturae* of 1735; the genera were grouped basically into classes according to their number of stamens, into orders according to their number of pistils. *Cucurbita* comes under Class 21, Monoecia, described as "Mares habitant cum feminis in eadem domo, sed diverso thalamo. Flores masculi et feminei in eadem planta sunt." Besides being monoecious, *Cucurbita* is described as Syngenesia, or "Mariti genitalibus foedus constituerunt. Stamina antheris (raro filamentis) in-cylindrum coalita." English translations of Linnaeus' Latin were made in 1783 by "a Botanical Society" with thanks for the help of Dr. Samuel Johnson. These translations appear in the Ray Society's 1957 facsimile edition of Vol. 1 of the *Species Plantarum* in the introductory section, "Linnaeus's Sexual System of Classification", and lead one to suspect the learned doctor of baiting with tongue in cheek those botanists who had earlier described Linnaeus' mathematical system as "lewd" and "licentious".



and Blunt. Published by Ferdinand Bernhard Vietz, 10 quarto volumes including 1086 hand-colored engraved plates, *Icones plantarum medico-oekonomico-technologicarum*, appeared at Vienna between 1800 and 1820. The plate of *Cucurbita Pepo* is large, printed on a folded double page, and has a great deal of charm. A *Lagenaria* plate is also ascribed to Vietz, but it is not included among the volumes (1-3) in the Missouri Botanical Garden library.

I bring in Curtis' *Botanical Magazine* now because its earliest plate of one of the key genera fits chronologically into the list of "icones" at this point. Actually, publication of this splendid serial began in 1787 and has continued almost uninterrupted until the present day, practically all of its plates being hand-colored until as late as 1948!

William Curtis, Praefectus Horti and Demonstrator to the Society of Apothecaries at Chelsea, founded the magazine to describe and illustrate "the most Ornamental FOREIGN PLANTS", the illustrations to be "always drawn from the living plant". When Curtis died the editorship was taken over by his friend, J. Sims. Sims' plate 1638, published in 1814, gives (as mentioned above) Cavanilles as a reference for his *Luffa acutangula*, a lovely copper engraving, probably by Sansom, from a drawing by Sydenham Edwards. Edwards is described by Blunt (1951) as "Curtis' own creation", as it was Curtis who recognized talent in the son of a Welsh schoolmaster, and brought him to London for instruction. Edwards remained practically the sole illustrator of the *Botanical Magazine* from the publication of the second volume in 1788 until 1815, some years after Curtis' death; he is credited with about 1650 plates!

The only other of the key genera illustrated among the nearly 10,000 plates in the *Botanical Magazine* is a *Fevillea cordifolia*, plate 6356, published in 1878. It presents an interesting contrast to the *Luffa*, as this was a period of low ebb in the printing arts; it is lithographed on poor quality paper, and has none of the charm or calligraphic quality of either earlier or later plates. At this time J. D. Hooker was editor, and it was under him that "the last traces of the Linnaean System vanished from the classification of plants in the *Botanical Magazine*" (Blunt, 1951). Sir Joseph Hooker is best known as an early champion of Darwin and for his botanical explorations, which contributed greatly to the knowledge of plant geography.

W. Fitch, artist of the *Fevillea* plate, was "discovered" by William Hooker, father of Sir Joseph, while the to-be-Director of Kew Gardens was a professor of botany and the to-be-artist an apprentice designer of calico, both in Glasgow (Blunt, 1951). Sir Joseph Hooker, after inheriting this enormously prolific draftsman, described him as an "incomparable botanical artist", with "unrivalled skill in seizing the natural character of a plant". Blunt (1951) finds his work too facile and insensitive, but adds that Fitch "remains the most outstanding botanical artist of his day in Europe", despite the fact that his drawings were made from dried plants. Blunt gives him additional credit as the first artist to be able to do this satisfactorily. Otto Stapf, editor of vols. 148-156 of the *Botanical Magazine*, has given a satisfying explanation of why this was possible:

"Fitch had a marvelous power of visualizing plants as they lived and retaining their image in his memory. This emboldened him rather to treat his originals as sketches than to work them into finished pictures, with the result that when finally drawn on stone they underwent a certain generalization in which the type of the species came to life and took the place of a photographically true portrait." (Quoted from Blunt, 1951.)

This statement concerning Fitch's method<sup>17</sup> is of interest in relation to my earlier discussion of "icones" as essentially portraits of species rather than of individuals as were the woodcuts of Weiditz.

François Pierre Chaumeton, "docteur en médecine", well understood the value of fine botanical illustration. "There are few sciences", he wrote in the preface to his *Flore Médicale*, 1814-20, "which demand more imperiously than botany, the help of painting. One would have to try very hard indeed to replace it with the most precise description". A doctor with such an opinion would also try very hard indeed to illustrate his book with the most precise drawings, and Chaumeton did just that. His two pictures of *Cucurbita Pepo* were made by P. J. F. Turpin, one of the great botanical draughtsmen of the day. Turpin worked with botanists of the highest caliber, Poiteau and de Candolle, as well as illustrating many of the American plants pictured in Humboldt, Bonpland and Kunth's publication concerning the expedition to the "régions équinoxiales du Nouveau Continent, 1799-1804".<sup>18</sup>

Turpin is described as being largely self-taught, but Blunt (1951) sees in his work "great indebtedness to the tradition of van Spaendonck and Redouté", both artists from whom no follower need feel shame to borrow. Elizabeth Mongan (1952) gives an excellent explanation for this:

"France became pre-eminent in the art of botanical flower prints at the beginning of the nineteenth century with such artists as Redouté, Prévost, Bessa, Turpin, Poiteau and Madame Vincent. They were all the pupils of van Spaendonck, and the skill of these artists can be attributed almost entirely to the thorough training they had had with such a master, but there was another reason for their ascendancy. This was their use of stipple engraving, a method that made possible color printing *à la poupée*.<sup>19</sup> Such excellence as these artists attained could not have been achieved by the use of the etched or engraved line that necessitated coloring of the print by hand."

Two years after Chaumeton began publishing the various editions of his work (folio, quarto and octavo), publication began, under the general direction of Cuvier,<sup>20</sup> of the *Dictionnaire des Sciences Naturelles*. This was a most ambitious work, appearing in Paris between 1816-30 in 60 volumes of text, with 14 of atlas, and planned (according to the title page) to "treat methodically the various natural beings, from the point of view of our knowledge of them and also relative

<sup>17</sup> Fitch also published eight interesting articles on the subject of botanical drawing, which appeared in *The Gardeners' Chronicle* in 1869. These elaborate his method in great detail, but contribute nothing new to a discussion of what constitutes living portraits of plants, or "icones".

<sup>18</sup> Among these was a so-called *Fevillea*, but Cogniaux relegated it to the genus *Sicydium*, so the great *Nova genera et species plantarum* (better known as "H.B.K.") of 1815-25 is not included in this discussion.

<sup>19</sup> "That is, the plate was daubed in various colors with tightly knotted cloths, resembling rag dolls (*poupées*) and then the whole thing printed at once." (Van Schaack, 1959.)

<sup>20</sup> Georges Léopold Chrétien Frédéric Dagobert, the Baron Cuvier (1769-1832), was a French zoologist who, among other high positions, held the post of Professor of Comparative Anatomy at the Jardin des Plantes.

to their use in medicine, agriculture, business and the arts". DeJussieu<sup>21</sup> was originally in charge of the botanical section; Turpin of the execution of the drawings and the general direction of the engraving. Unfortunately Turpin made only two plates among the key genera, both of *Fevillea cordifolia* (see plates XII and XIII). Turpin's drawings of botanical detail are generally acknowledged to be exceptionally fine, and these plates well illustrate the fact. One of the plates, for instance, depicts not only a "sterile" (male) flower in natural size, but a view of it from below: the androecium; a single stamen; and a view of it from the rear. Equally detailed dissections are made of a "fertile" (female) flower; and, need I add, the habit of the plant is also shown, all in one beautiful, colored, octavo page.

In 1821, M. E. Descourtilz published in Paris his 8 volumes on the *Flore Médicale des Antilles*, an assemblage made while he, a doctor, served in official capacity at Santo Domingo. Descourtilz used illustrations of several of the key genera (*Cucurbita moschata*, *C. Pepo*—both of which are pictured twice under different names; *Fevillea cordifolia* and *Lagenaria vulgaris*); these pictures have a good deal of charm, but are poor specimens of botanical illustration, despite the fact that the author claims to have drawn them from nature and to have watched his son cut them down in size before painting them with the greatest care. Though the father claims that his son Théodore was a pupil of the "célèbre Wanspaendonck", the slipshod attempt at portrayal of detail is only a sort of casual acknowledgment of its desirability. In contrast to the works of Turpin, these are sad indeed.

#### LITHOGRAPHS

The eleven large folio volumes of Velloso's *Florae fluminensis icones*, published in Paris in 1827-32, illustrate the flora of the region around Rio de Janeiro. Velloso was a native Brazilian who became one of the most zealous students of Domenico Vandelli, the Italian botanical explorer, and is thought to have supplied most of the plants described in Vandelli's works (Nissen, 1951).

Velloso must have been an ardent botanist to collect so many plants, but the art work in his book leaves much to be desired. The de Candolles (1878) wrote that "the figures [of *Florae fluminensis*] like those of Plumier, are very bad. The safest thing is to class the species of these authors . . . in a very doubtful category, which one can call *inextricables*". The figures do, however, play some part in the history of the graphic arts as they were lithographed by Senefelder, who discovered the process "almost accidentally" (Blunt, 1951) in 1797. The advantage of lithography, the technique employed in all the remaining "icones" on my list except those of Linnaeus and Bailey, is that it permits subtle gradations of line; as is readily seen in his *Fevillea trilobata*, *Luffa cylindrica* and two *Lagenarias*, however, Velloso did not profit from this opportunity, but drew in bold outline only.

The next "icones" on the list also illustrate Brazilian plants. Karl Friederich Philipp von Martius, a German botanist and traveler, was sent to Brazil in 1817 by the king of Bavaria. He returned to positions at the botanical garden and the university in Munich, where he began work on his *Flora Brasiliensis* in 1840.

<sup>21</sup> Antoine Laurent de Jussieu (1748-1836) is known as the first taxonomist to present a natural system of plants, actually an improved version of one assembled, but never published, by his uncle, Antoine. In 1793, the younger Antoine founded one of Europe's great museums, the Musée d'Histoire Naturelle de Paris (Lawrence, 1951).

Fifteen volumes in 40 folio parts were published between that date and 1906 in Munich, Vienna and Leipzig, the later volumes, of course, edited by younger men. The 3000 lithographs in the series were made by a number of artists, and include a *Fevillea trilobata* and a *Luffa operculata*, both of which are drawn in unusually fine detail.

Robert Wight's *Icones plantarum Indiae orientalis*, 6 quarto volumes of lithographs published in Madras between 1840 and 1856, contains some of the botanically finest "icones" on my list. The two-page spread of *Cucurbita maxima* includes an extraordinarily complete floral analysis; the *Luffa cylindrica* is done in such detail that one sees even the fine webbing at the edge of the leaf. The two plates, drawn by the Indian artist Rungiah and lithographed by Dumphy, are typical of the work of several generations of talented native artists who worked in India at about this time (Nissen, 1951). Wight, however, was not too happy about the way they were printed, especially in the early volumes. He apologizes in his preface with the explanation that lithography, still in its infancy in Europe, was even more of a fledgling in Madras, where inexperienced printers had not yet learned to compensate for the atmospheric difficulties which affected the success or failure of the plates. Hooker and Thomson (1855) in their Introductory Essay to the *Flora Indica* call Wight's works "the most important contributions not only to Botany, but to Natural Science, which have ever been published in India".

#### LATER WORK IN VARIOUS TECHNIQUES

When discussing the botanical woodcuts of the 16th and 17th centuries, I expressed admiration for the manner in which Brunfels' and Fuchs' artists handled them, but welcomed warmly the increased grace and delicacy made possible by the technique of engraving. Now, in the last quarter of the 19th century, we find a series of woodcuts so beautiful and finely made that one is forced to realize (as one always is!) that a great artist in any field surmounts the limitations of his medium. These effusions are aroused by Yokusai linuma's *Somoku-dzusetsu* or "Illustrated Flora of Japan". The set at the Missouri Botanical Garden is the second edition, printed at Ogaki in 1874 on rice paper of the highest quality. The set consists of 20 quarto volumes in which the illustrations (*Cucurbita Pepo*, 2 *Lagenaria vulgaris* and *Luffa cylindrica*) of my key genera extend across two pages.

In discussing the beautiful woodcuts of Fuchs, I pointed out that, in black and white, they sometimes appeared to be drawn in too thin outline, having obviously been designed with the intent that they be colored by hand. In these Japanese cuts the opposite is often true; the body of the figure is inked and the line, remaining white, is so fine as to seem almost impossible of achievement. In several of the plates I cite, the enlargements of the anther column and gynoecium are printed in color. Nissen, the verbose and usually all-seeing, only notes the *Somoku-dzusetsu* in a list for which he expresses gratitude to others; and, to my surprise, Blunt (1951) says only that it is illustrated with "effective woodcuts".

Manuel Blanco, in the third edition of whose *Flora de Filipinas* we find a *Cucurbita Pepo* and two *Luffas* (*L. acutangula* and *L. cylindrica*), was an Augustinian monk with no training whatsoever in botany, and a botanical library con-

sisting only of one volume of Linnaeus. Hooker and Thomson (1855) in their Introductory Essay call his first edition of 1837 a "botanical curiosity", a statement which covers its reception in Europe, though it met with great local acclaim. Neither the first nor the second edition was illustrated. The third is the work of Fathers Celestino Fernandez Villar and Andres Naves, whose only contribution, according to Merrill (1918), is their Latin translations which made Blanco's Spanish descriptions more generally accessible. The identifications of the plates (drawn by F. Domingo and lithographed by C. Verdaguer) show many errors, a large number of them referring to species which Blanco had never seen. None of the plates of the key genera falls within this category, however. Nissen (1951) goes so far as to damn the illustrations of this deluxe edition by praise so faint it hardly fits the definition. Neither the drawings nor their lithographic reproductions, he felt, compare with the quality of "the old work", but must be compared with their contemporaries, all, by inference, very bad indeed.

*Field and Garden Crops* of Duthie and Fuller, published in Roorkee in 1882-93, is not mentioned by Blunt or Nissen, nor do its illustrations appear in any of the exhibition catalogues, but the lithographs of *Cucurbita moschata*, *Lagenaria vulgaris* and *Luffa cylindrica*, albeit utterly lacking in artistic pretension or value, merit place in my list through their other qualifications. The artist of the plates, H. Hormusji, a Parsee imported from the Bombay School of Art, drew the botanical details with great care, and, though they are not pretty, his pictures are surely portraits of living plants. J. F. Duthie was Superintendent of the Saharanpur Botanical Gardens; J. B. Fuller, Director of Agriculture and Commerce for the Northwestern Provinces and Oudh.

Carlos Bettfreund's 3 octavo volumes, *Flora Argentina*, published in Buenos Aires between 1898 and 1901, deal with the "plantas vivas" of Argentina, and are illustrated in the manner of the period, with poorly colored lithographs of no artistic, but presumably some botanical value. These include a *Cucurbita Pepo* and a *Lagenaria vulgaris*. The same criticism may be leveled at F. Gagnepain's section on the Cucurbitaceae in Lecomte's *Flore Générale de l'Indo-Chine*, published in Paris in 1921. This contains a *Luffa cylindrica* drawn, according to the plate, by Mlles. Vesque. I find no mention of this name elsewhere, presumably because the quality of work does not redound to the glory of the artists.

My criteria for "icones" have had to be as much contorted to include the last two publications, as they were also to stretch across the post-Fuchsian herbals. Now they can return to their original shape, though they must, perhaps, still retain a fair amount of elasticity. Engler's *Das Pflanzenreich* would not be found on library shelves under the heading of "icones", nor would its many volumes find their way into the collection of a bibliophile. They do contain, however, besides the most universally accepted system of plant classification, a number of fine drawings of plants. Of the key genera, only a *Fevillea trilobata* appears on a full page and includes the habit of the plant, but I am grateful for it, because it is the best of its type of illustration, apparently the closest we will come, in our time, to fulfilling the criteria for "icones". The *Fevillea* plate contains precise and accurate botanical detail and, though not showy in the slightest lampshadish way, gives a



very pleasant impression of being a portrait of a living plant. This opinion is blessed by Blunt (1951), who points out that many of the illustrations used by Engler, the "greatest of German taxonomists" were unsigned works of Joseph Pohl, whose drawings were "conscientious, accurate, useful and in great quantity, but not on a high artistic level". Of even more significance in these, our troubled times, is the fact that they were made from specimens in the Berlin Herbarium, subsequently destroyed during World War II.

A full-page illustration of *Fevillea cordifolia* in Rendle's *Classification of Flowering Plants* squeezes in among the "icones" by the same reasoning as does Engler's *F. trilobata*. The picture is in Rendle's second volume, which did not appear until 1925, although the first was published in 1904, at which time the material for the second was "almost finished" (Burkill, 1938). It is impossible, therefore, to know if I have placed the book in proper chronological sequence. For our purposes, however, it is only important that we have here again a carefully drawn plant portrait, containing details acceptable to a distinguished taxonomist. Rendle joined the Department of Botany at the British Museum at the age of twenty-three, in 1888, and remained there for fifty years, pursuing, according to his "keen conception of his duty", his work in systematics. Burkill (1938) further describes him as one of those "ships which, as they leave port, have their course set for the whole voyage". He held many botanical posts of honor and responsibility, but his interest was always directed toward taxonomy.

L. H. Bailey's *Garden of Gourds*, a quarto volume issued in New York in 1937, is illustrated with a number of zincograph black and white plates mechanically reproduced from pen and ink drawings. Again, they are of no artistic value, but are pleasing and contain fine botanical detail acceptable to the author, an acknowledged authority on cultivated plants. Of the many illustrations of key genera printed in Bailey's book, I have listed as "icones" only those which best give an impression of habit: "Wild Texas Gourd", "Egg Gourd", "Apple Gourd", "Big Bell Gourd" and "White Pear Gourd", all belonging to the species *Cucurbita Pepo*, var. *ovifera*; *Lagenaria vulgaris* or *Luffa cylindrica*.

#### CONCLUSION

Bailey's book contains the last of my "icones", representing well a type of illustration with which it seems that we must learn in these latter days to satisfy ourselves. Botanically they are, of course, authoritative, but they grade very low on the artistic scale, as do all the last group listed. Actually there have been very few on my list that rate high both artistically and botanically, but it must be remembered that this is probably because the key plants do not appeal as floral décor, and have not posed for most of the best-known botanical artists.

Of the publications listed, only Fuchs in the 16th century and Rheede in the 17th contain "icones" that completely fulfill the requirements of my definition—size, habit, botanical accuracy and artistic value; Rumpf, Plumier, Buch'oz and Cavanilles in the 18th century meet the criteria in varying degree, all being at the very least large, fine books from the bibliophile's point of view.

Schkuhr, Zorn, Vietz, Curtis' *Botanical Magazine*, Chaumeton, the *Diction-*



*naire des Sciences Naturelles* and Descourtilz are less pretentious publications of the late 18th and early 19th centuries, with the happy artistic addition of color, again complying with my requirements to some degree.

Velloso and Martius return to the grand scale, but are more pretentious than beautiful, and poor Velloso is also not held in very high botanical esteem. From these two on, except for the Japanese work of Inuma, the artistic measure must be dropped entirely, or my list would have to end. I cannot describe Bailey's book (more attractive at least than the others) by even so slight a word of praise as charming, and there is no more temptation to use his illustrations than Engler's or Rendle's on my lamps. This may be a good thing; if the paper is of decent quality, the bookworms stay away, and if anybody supports our libraries, the books may be preserved, as books, for posterity. Though beauty is no longer important in these publications, botanical accuracy is a *sine qua non*; for this reason and with the message of Dr. Trelease still in mind, we can feel sure that they will serve the purposes of mankind for a very long time to come.

For the sake of consistency in the following indices I have employed the spelling of authors' names used by Nissen (1951), because his bibliography is the most complete I have found. This has led to one or two unfamiliar spellings, as "Karl von Linné" and "Rumpf". Consequently, I have used the name "Linnaeus" in the text, as it is the familiar form in American botany.

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## CHRONOLOGICAL INDEX OF "ICONES" OF KEY SPECIES

*Cucurbita foetidissima*:

- 1552, *Badianus Manuscript*: "Ayonelhuatl", p. 193, pl. 109.

*Cucurbita maxima*:

- 1576, L'Obel: "Pepo maximus Indicus compressus", p. 365.  
 1587, Dalechamps: "Pepo maximus Indicus, L'Obel", vol. I, p. 626.  
 1591, L'Obel: "Pepo maximus Indicus compressus", p. 641.  
 1616, Dodoens: "Pepo rotundus maior", p. 666.  
 1636, Gerarde: "Pepo maximus compressus", p. 920.  
 1650, Bauhin: "Cucurbita aspera, folio non fisso, fructu maximo, albo sessili", vol. II, p. 221.  
 1800, Vietz: "Cucurbita Pepo", vol. II, p. 80, pl. 148 (double page).  
 1840, Wight: *C. maxima*, vol. II, pl. 507 (double page).

*Cucurbita moschata*:

- 1678, Rheede: "Schakeri-Schora", vol. VIII, pl. 2.  
 ?1741, Rumpf: "Cucurbita Indica vulgaris, Pepones Labo", vol. V, p. 399, pl. 145.  
 1821, Descourtilz: "Courge Giraumon à Verrues", vol. V, p. 74, pl. 322; and "Courge Giraumon Veine", vol. V, p. 79, pl. 323.  
 1882, Duthie and Fuller: *C. moschata*, vol. II, pls. 58 and 59; and *C. moschata*, var., vol. II, pls. 60 and 61.

*Cucurbita Pepo*:

- 1542, Fuchs: "Cucumis Turcicus", p. 698; and "Cucumer marinus", p. 699.  
 1545, Fuchs: "Cucumis Turcicus", p. 402; and "Cucumer marinus", p. 403.  
 1558, Matthiolus: "Zucche Indiane", p. 292.  
 1560, Matthiolus: "Cucurbita Indica", p. 292.  
 1563, Dodoens: "Pepones lati", "Pepones rotundi" and "Pepones magni", p. 508.  
 1576, L'Obel: "Pepo oblongus vulgarissimus" and "Pepo rotundus compressus, Melonis effigie", both on p. 365.  
 1587, Dalechamps: "Cucurbita Indica rotunda", vol. I, p. 616; "Cucurbita Indica longa" and "Cucurbita verrucosa", vol. II, p. 612.  
 1591, Tabernaemontanus: "Pepo maximus oblongus", "Meloepo compressus" and "Meloepo-teres", vol. II, p. 178; "Pepo Indicus minor angulosus", vol. II, p. 179; "Cucurbita longa", vol. II, p. 182.  
 1591, L'Obel: "Pepo oblongus", p. 641; "Pepo rotundus compressus, Melonis effigie", p. 642.  
 1597, Gerarde: "Pepo maximus rotundus" and "Pepo maximus oblongus", p. 773; "Pepo maximus compressus" and "Pepo Indicus angulosus", p. 774.  
 1616, Dodoens: "Pepo maior oblongus", p. 665; "Pepo rotundus minor" and "Pepo latus", p. 666.  
 1636, Gerarde: "Pepo maximus oblongus", p. 919; "Pepo Indicus angulosus" and "Pepo Indicus minor rotundus", p. 920; "Pepo minor sylvestris" and "Pepo maior sylvestris", p. 922.  
 1640, Parkinson: "Melo Indicus parvus", p. 772.  
 1650, Bauhin: "Cucurbita foliis asperis sive Zucha flore luteo, lcs. I, II, III, IV, V", vol. II, p. 218-219; "Pepo Indicus minor angulosus, Tabern.", vol. II, p. 226; "Pepo Indica minor Tabern.", vol. II, p. 227; "Cucurbita verrucosa", vol. II, p. 222.  
 ?1741, Rumpf: "Cucurbita Indica vulgaris, Pepones Labo", vol. V, p. 399, pl. 145.  
 1775, Buch'oz: *C. Pepo*, Decad. 7, pl. 2.  
 1814, Chaumeton: "Citrouille", vol. III, pl. 123 and 123 bis.  
 1821, Descourtilz: "Courge patisson", vol. V, p. 82, pl. 324; "Courge Pepon", vol. V, p. 89, pl. 326.  
 1874, Linuma: *C. Pepo*, vol. II, pl. 43 and 43 bis.  
 1877, Blanco: "Cucurbita sulcata or maxima", atlas II, pl. 320.  
 1898, Bettfreund: "Cucurbita lagenaria", vol. II, p. 123.

*C. Pepo*, var. *ovifera*:

- 1791, Schkuhr: "Cucurbita ovifera", vol. VI, pl. 314.  
 1937, Bailey: "Wild Texas Gourd", p. 5; "Egg Gourd", p. 7 and 11; "Apple Gourd", p. 13; "Big Bell Gourd", p. 29; and "White Pear Gourd", p. 33.

*C. Pepo*, var. *Meloepo*:

- 1591, Tabernaemontanus: "Meloepo clypeatus", vol. II, p. 178; "Pepo Indicus minor clypeatus", vol. II, p. 179; "Cucurbita capitata", vol. II, p. 181.  
 1597, Gerarde: "Pepo maximus clypeatus", p. 774; "Pepo Indicus fungiformis", p. 775; "Cucurbita sylvestris fungiformis", p. 779.

- 1636, Gerarde: "*Cucurbita sylvestris fungiformis*", p. 924.  
 1650, Bauhin: "*Cucurbita clypeiformis cortice molli, et ramosa*", "*Cucurbita capitata Tabernomontani sive clypeiformis*", vol. II, p. 225; "*Cucurbita clypeiformis sive Siciliana, Melopepon latus a nonnullis vocata*", vol. II, p. 224.

*Fevillea cordifolia*:

- 1755, Plumier: "*Fevillea foliis cordatis*", p. 203, pl. 209.  
 1816, *Dictionnaire des Sciences Naturelles*: "*Fevillea hederacea*, Poir.", vol. LXIII, pl. 210 and 211.  
 1821, Descourtilz: "*Nandhirobe à Feuilles de Lierre*", vol. II, p. 216, pl. 198.  
 1925, Rendle: *Fevillea cordifolia*, vol. II, p. 222.

*Fevillea cordifolia*, var. *hederacea*:

- 1755, Plumier: "*Fevillea foliis trilobis*", p. 204, pl. 210.

*Fevillea Moorei*:

- 1878, Curtis' *Botanical Magazine*: *F. Moorei* Hook, 3rd series, vol. XXXIV, 1878, pl. 6356.

*Fevillea trilobata*:

- 1648, Marcgrave-Piso: "*Ghandiroba vel Nhandiroba*", Lib. I, p. 46.  
 1658, Piso: "*Nhandiroba*", Cap. LXVI, p. 259.  
 1827, Velloso: "*Fevillea cordifolia*", vol. X, pl. 102.  
 1878, Martius: *F. trilobata*, vol. VI, pt. 4, pl. 37.  
 1916, Engler: *F. trilobata*, vol. IV, 275, I, p. 6.

*Lagenaria vulgaris*:

- 1542, 1545, Fuchs: "*Cucurbita maior*", pp. 368 and 209, resp.; "*Cucurbita minor*", pp. 369 and 210, resp.; "*Cucurbita oblonga*", pp. 370 and 211, resp.  
 1563, Dodoens: "*Cucurbita cameraria maior*" and "*Cucurbita minor*", p. 511; "*Cucurbita anguina*", p. 512.  
 1576, L'Obel: "*Cucurbita sive zuccha, omnium maxima anguina*", and "*Cucurbita lagenaria*", p. 366.  
 1587, Dalechamps: "*Cucurbita cameraria minor*" and "*Cucurbita cameraria maior*", vol. I, p. 616.  
 1591, L'Obel: "*Cucurbita sive zuccha omnium maxima anguina*" and "*Cucurbita lagenaria*", p. 644.  
 1591, Tabernaemontanus: "*Cucurbita lagenaria maior*", vol. II, p. 181; "*Cucurbita Indica minor*" and "*Cucurbita lagenaria minor*", vol. II, p. 182.  
 1597, Gerarde: "*Cucurbita anguina*" and "*Cucurbita lagenaria*", p. 777; "*Cucurbita lagenaria sylvestris*", p. 779.  
 1616, Dodoens: "*Cucurbita prior*", p. 668; "*Cucurbita longior*" and "*Cucurbita latior*", p. 669.  
 1636, Gerarde: "*Cucurbita lagenaria*" and "*Cucurbita anguina*", p. 923; "*Cucurbita lagenaria sylvestris*", p. 924.  
 1640, Parkinson: "*Cucurbita lagenaria maior*" and "*Cucurbita longa*", p. 769.  
 1650, Bauhin: "*Cucurbita longa, folio molli, flore albo*", vol. II, p. 214; "*Cucurbita latior folio molli, flore albo*", vol. II, p. 215; "*Cucurbita lagenaria*", vol. II, p. 216.  
 1678, Rheede: "*Bela-Schora*", vol. VIII, pl. 1; "*Caca Palam*", vol. VIII, pl. 4; "*Caipa Schora*", vol. VIII, pl. 5.  
 1741, Rumpf: "*Cucurbita lagenaria*", vol. V, p. 398, pl. 144.  
 1779, 1796, Zorn-Oskamp: "*Cucurbita lagenaria*", vol. VI, pl. 597 and 598 and vol. IV, pl. 320 and 321, resp.  
 1821, Descourtilz: "*Courge calebasse*", vol. V, pl. 325.  
 1827, Velloso: "*Cucurbita lagenaria*", vol. X, pl. 98; "*Cucurbita Pepo*", vol. X, pl. 100.  
 1874, Inuma: "*Lagenaria Dasistemom* Miq.", vol. XX, pl. 44; "*Lagenaria vulgaris*, Ser.", vol. XX, pl. 45.  
 1882, Duthie and Fuller: *Lagenaria*, vol. II, pl. 48.  
 1898, Bettfreund: *Lagenaria vulgaris*, vol. I, p. 58.  
 1937, Bailey: *Lagenaria*, p. 93.

*Luffa acutangula*:

- 1678, Rheede: "*Picinna*", vol. VIII, pl. 7.  
 1741, Rumpf: "*Petola bengalensis*", vol. V, p. 408, pl. 149.  
 1791, Cavanilles: "*Luffa foetida*", vol. I, pl. 9 and 10.  
 1814, Curtis' *Botanical Magazine*: "*Luffa foetida*", 1st series, vol. XXXIX, 1814, pl. 1638.  
 1877, Blanco: "*Cucumis acutangulis*", atlas II, pl. 288.  
 1882, Duthie and Fuller: *L. acutangula*, vol. II, pl. 62.

*Luffa cylindrica*:

- 1638, Vesling: "Luffa Arabum, seu Cucumis retici latus Aegyptius", pp. 50 and 51.  
 1678, Rheede: "Catu picinna", vol. VIII, pl. 7.  
 1741, Rumpf: "Petola sylvestris", vol. V, p. 410, pl. 150; "Petola Tschina", vol. V, p. 406, pl. 147.  
 1827, Velloso: "Momordica carinata", vol. X, pl. 97.  
 1840, Wight: "Luffa pentandra", vol. II, pl. 499.  
 1874, Linuma: "Luffa petola, Ser.", vol. XX, pl. 36.  
 1877, Blanco: "Luffa petola", atlas II, pl. 334.  
 1882, Duthie and Fuller: "Luffa Aegyptiaca", vol. II, pl. 63.  
 1907, Lecomte: *L. cylindrica*, vol. II, p. 1074.  
 1924, Engler: *L. cylindrica*, vol. IV. 275. II, p. 66.  
 1937, Bailey: *L. cylindrica*, p. 105.

*Luffa echinata*:

- 1924, Engler: *L. echinata*, vol. IV. 275. II, p. 70.

*Luffa operculata*:

- 1706, Commelin: "Momordica Americana Fructu Reticulata Sicco", fig. 22.  
 1878, Martius: *L. operculata*, vol. VI, pt. 4, pl. 1.  
 1924, Engler: *L. operculata*, vol. IV. 275. II, p. 70.

# INDEX, BY KEY SPECIES, OF WOODCUTS DERIVED FROM ONE SOURCE AND USED BY SEVERAL AUTHORS

("Mirror image" prints are reverse of earliest listed use of figure.)

*Cucurbita maxima*:

1. 1576, L'Obel: "Pepo maximus Indicus compressus"; 7 × 13 cms.  
 1587, Dalechamps: "Pepo maximus Indicus, L'Obel"; 7 × 12 cms.; mirror image.  
 1591, L'Obel: "Pepo maximus Indicus compressus"; 7 × 13 cms.  
 1616, Dodoens: "Pepo rotundus maior"; 7 × 13 cms.  
 1636, Gerarde: "Pepo maximus compressus"; 7 × 13 cms.  
 1650, Bauhin: "Cucurbita aspera, folio non fisso, fructu maximo, albo sessili"; 4½ × 8½ cms.; mirror image.

*Cucurbita Pepo*:

1. 1542, Fuchs: "Cucumer marinus"; folio page.  
 1545, Fuchs: "Cucumer marinus"; octavo page; mirror image.  
 1558, Matthioli: "Zucche Indiane"; 12 × 6½ cms.  
 1560, Matthioli: "Cucurbita Indica"; 12 × 6½ cms.  
 1563, Dodoens: "Pepones rotundi"; 12 × 7 cms.; mirror image.  
 1587, Dalechamps: "Cucurbita Indica rotunda"; 12 × 7 cms.; mirror image.  
 1616, Dodoens: "Pepo rotundus minor"; 12 × 7 cms.; mirror image.  
 1636, Gerarde: "Pepo minor sylvestris"; 12 × 7 cms.; mirror image.  
 1650, Bauhin: "Cucurbita foliis asperis sive Zucha flore luteo, Ic. V"; 8½ × 4½ cms.
2. 1542, Fuchs: "Cucumis Turcicus"; folio page.  
 1545, Fuchs: "Cucumis Turcicus"; octavo page; mirror image.  
 1563, Dodoens: "Pepones magni"; 12 × 7 cms.; mirror image.  
 1587, Dalechamps: "Cucurbita Indica longa"; 12 × 6½ cms.  
 1616, Dodoens: "Pepo maior oblongus"; 12 × 7 cms.; mirror image.  
 1636, Gerarde: "Pepo maximus oblongus"; 12 × 7 cms.; mirror image.  
 1650, Bauhin: "Cucurbita foliis asperis sive Zucha flore luteo, Ic. II"; 8½ × 4½ cms.
3. 1563, Dodoens: "Pepones lati"; 13 × 7½ cms.  
 1616, Dodoens: "Pepo latus"; 13 × 7½ cms.  
 1636, Gerarde: "Pepo Indicus angulosa"; 13 × 7½ cms.
4. 1576, L'Obel: "Pepo oblongus vulgatissimus"; 13 × 7 cms.  
 1591, L'Obel: "Pepo oblongus"; 13 × 7 cms.  
 1636, Gerarde: "Pepo maior sylvestris"; 13 × 7 cms.
5. 1576, L'Obel: "Pepo rotundus compressus Melonis effigie"; 13 × 7 cms.  
 1591, L'Obel: as above.  
 1636, Gerarde: "Pepo Indicus minor rotundus"; 13 × 7 cms.  
 1640, Parkinson: "Melo Indicus parvus"; 13 × 7 cms.
6. 1587, Dalechamps: "Cucurbita verrucosa"; 11 × 6½ cms.  
 1650, Bauhin: "Cucurbita verrucosa"; 8½ × 4½ cms.; mirror image.



7. 1591, Tabernaemontanus: "Cucurbita longa";  $12 \times 7\frac{1}{2}$  cms.  
1650, Bauhin: "Pepo Indicus minor, Tabern.";  $8\frac{1}{2} \times 4\frac{1}{2}$  cms.
8. 1591, Tabernaemontanus: "Meloepo compressus";  $12 \times 7\frac{1}{2}$  cms.  
1597, Gerarde: "Pepo maximus compressus";  $12 \times 7\frac{1}{2}$  cms.
9. 1591, Tabernaemontanus: "Meloepoteres";  $12 \times 7$  cms.  
1597, Gerarde: "Pepo maximus rotundus";  $12 \times 7$  cms.
10. 1591, Tabernaemontanus: "Pepo maximus oblongus";  $11\frac{1}{2} \times 7\frac{1}{2}$  cms.  
1597, Gerarde: as above.
11. 1591, Tabernaemontanus: "Pepo Indicus minor angulosus";  $12 \times 7\frac{1}{2}$  cms.  
1597, Gerarde: "Pepo Indicus angulosus";  $12 \times 7\frac{1}{2}$  cms.  
1650, Bauhin: "Pepo Indicus minor angulosus, Tabern.";  $9 \times 4\frac{1}{2}$  cms.; mirror image.

*Cucurbita Pepo*, var. *Meloepo*:

1. 1591, Tabernaemontanus: "Pepo Indicus minor clypeatus";  $12\frac{1}{4} \times 7\frac{1}{4}$  cms.  
1597, Gerarde: "Pepo Indicus fungiformis";  $12\frac{1}{4} \times 7\frac{1}{4}$  cms.  
1650, Bauhin: "Cucurbita clypeiformis cortice molli, et ramosa";  $8\frac{1}{2} \times 4\frac{1}{2}$  cms.; mirror image.
2. 1591, Tabernaemontanus: "Cucurbita capitata";  $12 \times 7\frac{1}{2}$  cms.  
1597, Gerarde: "Cucurbita sylvestris fungiformis";  $12 \times 7\frac{1}{2}$  cms.  
1636, Gerarde: as above.  
1650, Bauhin: "Cucurbita capitata Tabernomontani sive clypeiformis";  $8\frac{1}{2} \times 4\frac{1}{2}$  cms.; mirror image.
3. 1591, Tabernaemontanus: "Meloepo clypeatus";  $12\frac{1}{2} \times 7$  cms.  
1597, Gerarde: "Pepo maximus clypeatus";  $12\frac{1}{2} \times 7\frac{1}{2}$  cms.  
1650, Bauhin: "Cucurbita clypeiformis sive Siciliana, Meloepon latus a nonnullis vocata";  $8\frac{1}{2} \times 4\frac{1}{2}$  cms.; mirror image.

*Fevillea trilobata*:

1. 1648, Marcgrave-Piso: "Ghandiroba vel Nhandiroba";  $8 \times 14\frac{1}{2}$  cms.  
1658, Piso: "Nhandiroba";  $8 \times 14\frac{1}{2}$  cms.

*Lagenaria vulgaris*:

1. 1542, Fuchs: "Cucurbita oblonga"; folio page.  
1545, Fuchs: "Cucurbita oblonga"; octavo page; mirror image.  
1563, Dodoens: "Cucurbita anguina";  $12 \times 7$  cms.; mirror image.  
1650, Bauhin: "Cucurbita longa, folio molli, flore albo";  $8\frac{1}{2} \times 4\frac{1}{2}$  cms.
2. 1542, Fuchs: "Cucurbita maior"; folio page.  
1545, Fuchs: "Cucurbita maior"; octavo page; mirror image.  
1563, Dodoens: "Cucurbita cameraria maior";  $12 \times 6\frac{1}{2}$  cms.; mirror image.  
1587, Dalechamps: "Cucurbita cameraria maior";  $12 \times 6\frac{1}{2}$  cms.  
1636, Gerarde: "Cucurbita lagenaria";  $12 \times 6\frac{1}{2}$  cms.; mirror image.  
1650, Bauhin: "Cucurbita latior folio molli, flore albo";  $8\frac{1}{2} \times 5$  cms.
3. 1542, Fuchs: "Cucurbita minor"; folio page.  
1545, Fuchs: "Cucurbita minor"; octavo page; mirror image.  
1563, Dodoens: "Cucurbita minor";  $12 \times 7$  cms.; mirror image.  
1587, Dalechamps: "Cucurbita cameraria minor";  $11\frac{1}{2} \times 6\frac{1}{2}$  cms.  
1650, Bauhin: "Cucurbita lagenaria";  $8\frac{1}{2} \times 4\frac{1}{2}$  cms.
4. 1576, L'Obel: "Cucurbita sive zuccha omnium maxima anguina";  $13 \times 7$  cms.  
1591, L'Obel: as above.  
1616, Dodoens: "Cucurbita longior";  $13 \times 7$  cms.  
1636, Gerarde: "Cucurbita anguina";  $13 \times 7$  cms.  
1640, Parkinson: "Cucurbita longa";  $13 \times 7$  cms.
5. 1576, L'Obel: "Cucurbita lagenaria";  $13 \times 7$  cms.  
1591, L'Obel: as above.  
1616, Dodoens: "Cucurbita prior";  $13 \times 7$  cms.  
1636, Gerarde: "Cucurbita lagenaria sylvestris";  $13 \times 7$  cms.  
1640, Parkinson: "Cucurbita lagenaria maior";  $13 \times 7$  cms.
6. 1591, Tabernaemontanus: "Cucurbita Indica minor";  $12 \times 7\frac{1}{2}$  cms.  
1597, Gerarde: "Cucurbita anguina";  $12 \times 7\frac{1}{2}$  cms.
7. 1591, Tabernaemontanus: "Cucurbita lagenaria maior";  $12\frac{1}{2} \times 7$  cms.  
1597, Gerarde: "Cucurbita lagenaria";  $12\frac{1}{2} \times 7$  cms.
8. 1591, Tabernaemontanus: "Cucurbita lagenaria minor";  $12 \times 7\frac{1}{4}$  cms.  
1597, Gerarde: "Cucurbita lagenaria sylvestris";  $12 \times 7\frac{1}{4}$  cms.

## EXPLANATION OF PLATE

## PLATE XI

"Pepo" (*Cucurbita Pepo*), vol. II, pl. 33, *Institutiones rei herbariae*, Joseph Pitton de Tournefort, Paris, 1700.

Tab. 33.

Pepo



BOTANIQUE.

DICOTYLÉDONES.

Nandirobées. (St. Hl.)

55.



*Torpedo pinnatifida* (L.) DC.

*Torpedo ovata* (L.) DC.

NANDIROBE à feuilles de lierre.

## EXPLANATION OF PLATE

## PLATE XII

"Nandirobe à feuilles de lierre" (*Fevillea cordifolia*), vol. LXIII, pl. 210, *Dictionnaire des Sciences Naturelles*, Paris, 1816-30.

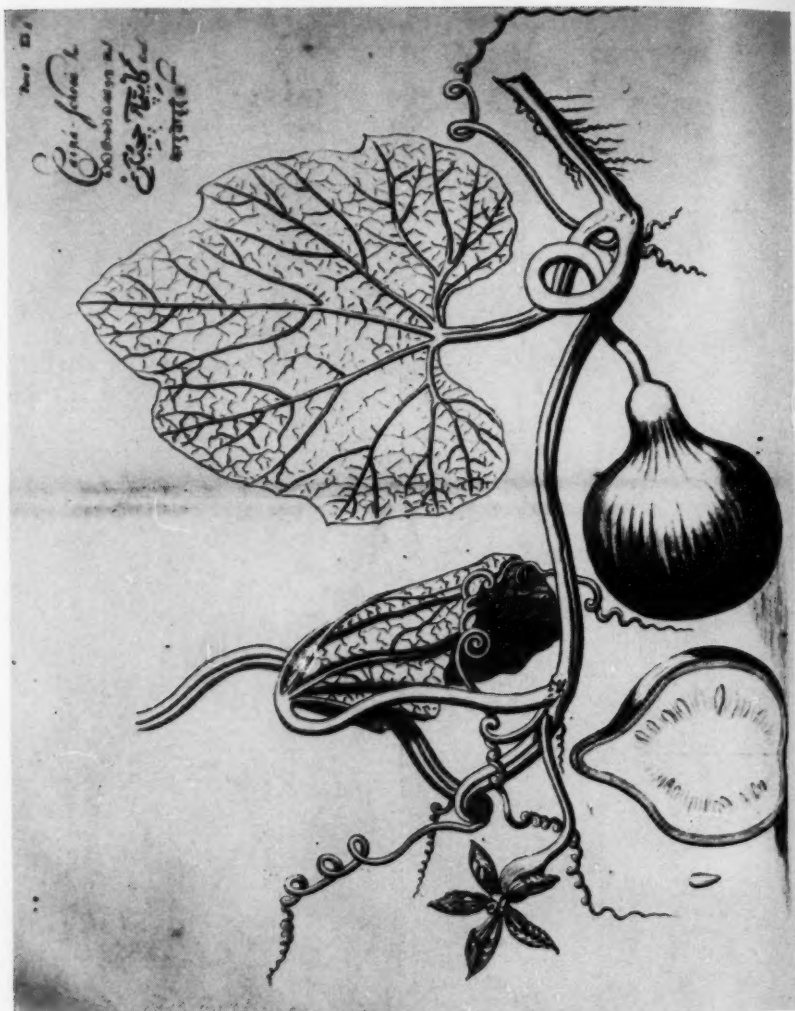
## EXPLANATION OF PLATE

## PLATE XIII

"Nandirobe à feuilles de lierre" (*Fevillea cordifolia*), vol. LXIII, pl. 211, *Dictionnaire des Sciences Naturelles*, Paris, 1816-30.







EISENDRATH—A STUDY OF THE ICONES

## EXPLANATION OF PLATE

## PLATE XIV

"Caipa Schora" (*Lagenaria vulgaris*), vol. VIII, pl. 5, *Hortus Indicus Malabaricus*,  
Hendrik Adrian van Rheede tot Draakestein, Amsterdam, 1678-1703.



## A SYNOPSIS OF POINSETTIA (EUPHORBIACEAE)

ROBERT L. DRESSLER

### ABSTRACT

The position of *Poinsettia* in the tribe Euphorbieae is discussed, and a key is given for the American genera. The name *P. heterophylla* is found to be applicable to a weedy tropical plant, and the distinctions between this and the North American *P. cyathophora* are tabulated. Gametic chromosome numbers of 14 and 28 are reported for both *P. cyathophora* and *P. dentata*, while *P. heterophylla* shows only  $n = 14$ . The geographic variation of the North American annual species is briefly discussed. A key is given for the 11 species recognized, of which two are described as new: *P. coccinea* and *P. inornata*, while new combinations are published in *Poinsettia* for *P. colorata*, *P. pentadactyla* and *P. restiacea*. ROBERT L. DRESSLER, Missouri Botanical Garden, 2315 Tower Grove Ave., St. Louis 10, Missouri.

There are not many species in the genus *Poinsettia*, but their bewildering foliar polymorphism has caused a great deal of confusion. While studying the genus *Pedilanthus* (Dressler 1957), some observations were made on other genera of the tribe Euphorbieae. In the summer of 1957 I was able to observe most of the North American species of *Poinsettia* in Mexico and the southwestern United States.\* Many collections made at that time have been grown and studied at the Missouri Botanical Garden. These observations have permitted considerable clarification of the annual species, especially. While I am no longer actively studying the Euphorbieae, it is felt that these notes on *Poinsettia* may be of some value.

### GENERIC CONCEPT

The Linnaean genus *Euphorbia*, as it is frequently used, includes most of the tribe Euphorbieae, and is surely the most broadly inclusive generic concept in modern usage (among flowering plants). I much prefer to recognize about fourteen genera in the tribe Euphorbieae, six of these being included in the genus *Euphorbia* by many authors. I have no quarrel with those who prefer the inclusive concept of *Euphorbia*, but feel that the same arguments could be used to reduce most Compositae to *Aster*, with about equal profit. In the narrower sense, *Euphorbia* is a distinctive group of about 80 Old World species which are woody or succulent, and usually have two spines (rarely 1) near each leaf base. These spines are frequently considered to be stipular, but true stipules appear to be present in addition to the spines. The large group of south African succulents which are spineless or have spines formed from axillary branches are not directly related to the above group. The earliest generic name for the south African group is *Medusea* Haw. Neither of these groups is represented in the New World, the American succulents being members of *Agaloma* or *Tithymalus*. The largest and most difficult of the segregate genera is *Tithymalus*, which is largely an Old World group, but includes three major American groups: (1) Primitive woody species, such as *Euphorbia* (*Tithymalus*) *fulva* Stapf and *Tithymalus calyculatus* (HBK.) Kl. & Gke., of the West Indies, Central America and the Andes. (2) Herbaceous

\* I am especially grateful to the Gray Herbarium and the National Science Foundation for their support of the field work in northeastern Mexico. Special thanks are also due Dr. Rogers McVaugh, who kindly lent material of *P. restiacea* which he collected, and Dr. John D. Dwyer, for aid with the Latin diagnoses.

perennials related to *Tithymalus chrysophyllus* Kl. & Gke. and *Euphorbia* (*Tithymalus*) *floridana* Chapm. This group includes two or three species of the southeastern United States and a number of southern South America, all of them with a conspicuous pistillate calyx. (3) Herbaceous species which are closely related to Old World sorts and are surely geologically late invaders of the New World. These include *Tithymalus commutatus* (Engelm.) Kl. & Gke. and *T. campester* (Cham. & Schlecht.) Kl. & Gke., and are largely montane forms. There are also a few anomolous species which do not fall into these groups, such as *Tithymalus trichotomus* (HBK.) Kl. & Gke. and *Euphorbia* (*Tithymalus*) *peroneura* Berger.

Most New World Euphorbieae belong to the distinctive group made up of *Agaloma*, *Poinsettia* and *Chamaesyce*. Of the three, *Chamaesyce* is most frequently treated as a distinct genus, while *Agaloma* generally has been kept in *Euphorbia*. These two groups are closely related, but can be distinguished by habit and by the distinctive leaf structure of *Chamaesyce*. While *Agaloma* can almost always be distinguished from *Tithymalus* by the appendaged glands, this feature is not infallible. The diminutive *Euphorbia misella* Watson, of alpine meadows in central and southern Mexico appears to lack gland appendages, but close scrutiny shows rudimentary appendages beneath the glands, indicating that it is a reduced member of *Agaloma*. Similarly, *Euphorbia heterophylla* var. *eriocarpa* Millsp. may belong in *Agaloma*, but lacks the gland appendages characteristic of that group (see excluded species, p. 340). *Agaloma* is greatly in need of monographic study, and there would be very little profit in wholesale new combinations made without such study. For this reason, I propose to cite the species of *Agaloma* as, for example, "*Euphorbia* (*Agaloma*) *corollata* L.," with the understanding that this group is quite distinct from true *Euphorbia*. The same system, of course, may be used for *Medusea*, or even *Tithymalus*. A tentative key to the New World genera of Euphorbieae is given below.

1. Leaves opposite or (rarely) ternate; the branching dichasial throughout; the veins of the leaves sheathed with chlorenchyma (usually visible by transmitted light)...CHAMAESYCE S. F. Gray
1. Leaves various; at least the base of the plant monopodial; leaf veins without distinct chlorenchyma sheaths. ....2
2. Glands of the involucre crenate or entire, often with two lateral horns, but without distinct petaloid appendages. ....3
3. Glands of the involucre 4 or 5, not cup-like or bilabiate.....TITHYMALUS Torr
3. Glands usually 1 or 2, cup-like, bilabiate, or shield-like.....4
4. The involucre lobes connate to their apices; two glands united into a lateral shield-like structure; the cymes pseudo-umbellate; the pistillate flowers calyculate.....CUBANTHUS Millsp.
4. The involucre lobes apically distinct; the gland cup-like or bilabiate; inflorescence a condensed pleiochasium or dichasium, the branches becoming monochasial; the pistillate flower naked.....POINSETTIA Griseb.
2. Glands of the involucre with distinct petaloid appendages, these often lacinate.....5
5. The involucre lobes equal; the gland appendages not forming a single hood-like spur. ....AGALOMA Raf.
5. The involucre highly zygomorphic, with 2 large lobes and 3 very small ones; the gland appendages forming a spur on one side of the involucre.....PEDILANTHUS Neck.

#### GENERIC RELATIONSHIPS

As noted above, *Poinsettia* is closely allied to *Agaloma*, though readily distinguished by the lack of petaloid appendages on the glands. *Euphorbia* (*Agaloma*) *lancifolia* Schlecht. is especially similar to *Poinsettia*, and resembles that genus in



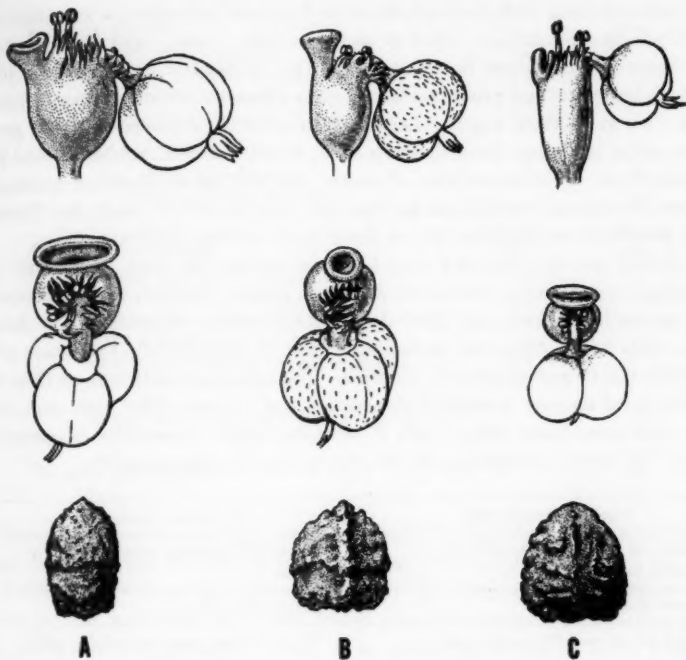


Figure 1. Cyathia and seed of the North American annual poinsettias. A. *P. cyathophora* (Dressler 2430), B. *P. heterophylla* (Dressler 2254), C. *P. dentata* (Dressler 2198). Above: side view of cyathium,  $\times 5$ ; middle: top view of cyathium,  $\times 5$ ; below: dorsal view of seed,  $\times 7.5$ . All drawn from fresh, living specimens.

habit, in the tendency toward reduced gland number, in the form of the glands, in the reduced petaloid appendages and in the thick-walled, coarsely reticulate pollen grains. The seed of *E. (A.) lancifolia* is very different from that of *Poinsettia*, which serves to reinforce the generic distinction. Several other species of *Agaloma* have been confused with *Poinsettia*, though they are less closely related (see excluded species, p. 340). *Poinsettia* is evidently derived from *Agaloma* by the loss of petaloid appendages and reduction in number of glands. While the involucre of *Poinsettia* generally has only a single gland, the central involucre of a pleiochasium, especially, is likely to have a full complement of five glands.

#### THE IDENTITY OF EUPHORBIA HETEROPHYLLA L.

Much of the confusion concerning the annual poinsettias has centered about the identity of Linnaeus' *Euphorbia heterophylla*. The epithet seems very descriptive of the familiar North American plant with red and green floral bracts, and most botanists seem to have assumed that it applied to this plant. One finds, though, that Linnaeus' epithet refers to the *shape* of the leaves, rather than to their color.

There is no specimen of *E. heterophylla* in the Linnaean herbarium, so one must turn to *Tithymalus curassavicus*, *salicis* & *atriplicis foliis varius*, *caulibus viridantibus* of Plukenet's *Almagestum Botanicum* (1696). Plukenet's figure shows a plant with both lanceolate and pandurate leaves, quite characteristic of the weedy tropical species with green floral bracts. Leaf shape is none too dependable in this group, but the entire lanceolate form shown is rarely encountered in the North American *P. cyathophora*. It is conceivable, of course, that the North American ornamental had been introduced into Curaçao by that date, but it is hardly likely that Plukenet would have failed to mention the red floral bracts of that species.

It should not be concluded that Linnaeus' epithet has been consistently and discerningly misapplied to the North American species. Rather, most specimens of either species from North and Central America have been determined as *E. heterophylla*, while South American specimens of true *E. heterophylla* have more often been labeled as *E. geniculata* or *E. elliptica*. The consistent confusion of these two species is based on very superficial observation, for the two differ from each other much more than either differs from *P. dentata*, which is generally recognized as distinct. A tabular comparison of the two species is given herewith.

<i>Poinsettia cyathophora</i>	<i>Poinsettia heterophylla</i>
Stems and petioles glabrous or sparsely pilose.	Stems and petioles often markedly pilose.
Leaves glossy green.	Leaves dull green.
Floral bracts usually basally red.	Floral bracts green or basally pale, never basally red (often purple spotted).
Gland broad, more or less bilabiate, the opening narrowly oblong.	Gland narrow, substipitate, the opening circular.
Seed finely and sharply tuberculate, not angular.	Seed coarsely and bluntly tuberculate, angular.

#### CHROMOSOME NUMBER

A number of chromosome counts have been made from material cultivated at Missouri Botanical Garden. These are given below, with the counts previously published by Perry (1943). Voucher specimens are available for all those which have collection numbers.

<i>Poinsettia cyathophora</i>	Gametic No.	Somatic No.
Dressler 1821 (Tamaulipas)	14	
Dressler 2271 (Tamaulipas)	14	
Dressler 2430 (Nuevo León)	14	
s. n. Washington, Missouri	14	
s. n. Grey Summit, Missouri	14	
Dressler 2373 (Tamaulipas)	28	
Cultivated (Rex Pearce)	28	
Cultivated (Parke)	28	
Perry (cult. as <i>Euphorbia heterophylla</i> )		56

<i>Poinsettia dentata</i>	Gametic No.	Somatic No.
Dressler 2268 (Oaxaca)	14	
s. n. Grey Summit, Missouri	14	
Dressler 2198 (Texas)	28	
s. n. Empalme Escobedo, Guanajuato	28	
Perry, Clarke Co., Virginia		14, 28
Davis, Oklahoma		28
Pleasant Hill, Missouri		56
<i>Poinsettia heterophylla</i>	Gametic No.	Somatic No.
Dressler 2136 (Tamaulipas)	14	
Dressler 2194 (Arizona)	14	
Dressler 2243 (Vera Cruz)	14	
Howard & Proctor 13883 (Jamaica)	14	
Manning & Manning 531217 (Jalisco)	14	
s. n. Soledad, Cuba	14	
Moyer (cited by Perry) as <i>E. geniculata</i>		28
<i>Poinsettia pulcherrima</i>		Somatic No.
Perry		28

From the above counts, one could consider 14 to be the base number for the genus, if it were not for Perry's record of a somatic number of 14 for one plant of *P. dentata*. It is at least conceivable that the plant studied by Perry was a chance haploid, but more counts are needed from the eastern United States, before this can be evaluated properly. There is no indication of polyploidy in *P. heterophylla*, but *P. cyathophora* and *P. dentata* both contain polyploids. These are discussed further in the next section.

#### PATTERNS OF VARIATION

The most outstanding feature of the annual species of *Poinsettia* is their extreme polymorphism. Linear-lanceolate, ovate and deeply pandurate leaves may be found not only in the same population, but on the same individual. More frequently, however, extremely different leaf types are found on different individuals or on different stages of one individual. It would appear that there is an interaction of genetic and environmental control in such cases. The perennial species are less markedly polymorphic, but all of the adequately sampled species show some degree of foliar polymorphism. Even seed structure shows a good deal of variation in *Poinsettia*, though this feature is usually dependably stable in the Euphorbieae.

In spite of the extreme polymorphism, some patterns of geographic or genetic variation are evident, and merit more detailed study.

1. *Poinsettia cyathophora*. This species is perhaps the most highly variable of the genus. The cultivated polyploids ( $n = 28$ ) are coarse, somewhat weedy plants that show little polymorphism, and have somewhat coriaceous leaves. When collected in a dry, rocky arroyo, the plants of Dressler 2373 were relatively small, but when cultivated in St. Louis, they became large and coarse, very closely resembling the cultivated plants of the same chromosome number. Many of the more delicate

plants of lower chromosome number would seem to have greater ornamental potential than the polyploids now available.

Collections from Oaxaca and Nuevo León have behaved as distinctly short-day plants, while one collection from Tamaulipas (Rancho del Cielo) has proven to be relatively day-neutral. The characteristic red bracts of this species are a surprisingly dependable key feature, but some plants of the Missouri Ozarks lack the red coloring.

2. *Poinsettia dentata*. This species shows a good deal of geographic variation, which is complicated by polyploidy. The plants with  $n = 14$  of southern Mexico are much branched and often decumbent, strongly pilose plants with very condensed, nearly capitate inflorescence and cream or yellowish floral bracts. This is apparently the form described as *Poinsettia schiedeana*. These features become less marked to the north, suggesting a clinal pattern. One also finds erect, rather weedy plants with little or no bract coloration in Mexico. These are frequent in disturbed areas of central Mexico, and closely resemble the forms of this species which grow in Arizona and western Texas. It is probable that these weedy forms have entered Mexico from the north and are genetically isolated from the native form by their higher chromosome number.

Some of the semi-desert forms from northern Mexico are striking because of their small, coriaceous leaves. The type of Engelmann's var. *rigida* is not the extreme in this feature.

3. *Poinsettia heterophylla*. This tropical species shows less variation than its temperate counterparts. Occasional populations with whitish floral bracts, strongly dentate leaves or very pilose stems suggest introgression from *P. dentata*, and I suspect that these two do hybridize to a certain degree where *P. heterophylla* grows with a population of *P. dentata* having the same chromosome number.

#### TAXONOMY

*POINSETTIA* Graham, Edinb. New Philos. Jour. 20:412. 1836. Type: *Euphorbia pulcherrima* Willd.

*Pleuradena* Raf., Atl. Jour. 1(6):182. 1833, not *Pleuradena* Raf., 1825. Type: *Pleuradena coccinea* Raf.

*Cyathophora* Raf., Fl. Tell. 4:117. 1838, not *Cyathophora* S. F. Gray, 1821. Type: *Euphorbia heterophylla* L.

Woody or herbaceous, often perennial from a fleshy storage root; leaves alternate or opposite, stipules inconspicuous or absent, appearing glandular; inflorescence a condensed pleiochasium or dichasium, the branches becoming monochasial; involucre glands more or less cup-like, usually reduced in number (commonly 1); pollen grains thick-walled and coarsely reticulate; pistillate flower naked.

#### KEY TO SPECIES

1. Plants woody, or perennial from thickened storage roots.....2
2. Woody plants, generally exceeding 2 meters in height; involucre usually more than 5 mm. in diameter; seeds ca. 10 mm. long.....1. *P. PULCHERRIMA*
2. Herbaceous plants, less than 1 meter tall; involucre usually less than 5 mm. in diameter; seeds 2-5 mm. long.....3

3. Plant ca. 1 dm. tall, flowering on short leafless stems, the vegetative stems developing later, usually more or less decumbent.....2. *P. RADIAN*
3. Plants 2-5 dm. tall; foliage and flowers borne on same stem, stems erect.....4
4. Floral bracts white; glands white, with the outer rim flaring and somewhat petaloid (western Mexico).....3. *P. RESTIACEA*
4. Floral bracts red or red and green; glands red, yellow or green, the outer rim not flaring and petaloid.....5
5. Leaves entire, markedly paler beneath (northwestern Mexico).....5. *P. COLORATA*
5. Leaves more or less serrate, not markedly paler beneath.....6
6. Foliage markedly scabrous-strigose; gland broadly campanulate, the inner and outer rims similar; seed 3-4 mm. long (western Mexico).....4. *P. STRIGOSA*
6. Foliage subglabrous; gland narrow, the outer rim much thicker than the inner; seed 2-2.5 mm. long (northeastern Mexico).....6. *P. COCCINEA*
1. Plants annual, without thickened storage roots.....7
7. Style branches (3) entire, about one half connate, much longer than the ovary (Paraguay and Argentina).....9. *P. PENTADACTYLA*
7. Style branches divided, not longer than the ovary.....8
8. Seeds smooth, with an equatorial row of blunt tubercles and one or two fainter rows; low spreading, delicate plant (Peru).....10. *P. INORNATA*
8. Seeds strongly tuberculate; generally coarser, erect plants.....9
9. Glands more or less funnel-like, the opening circular; coarse tropical weed.....11. *P. HETEROPHYLLA*
9. Glands more or less bilabiate, the opening narrowly oblong.....10
10. Lower leaves usually alternate; floral bracts usually basally red; seeds without caruncle (North America).....7. *P. CYATHOPHORA*
10. All leaves usually opposite; floral bracts green or cream at base, sometimes with purple spots, but never basally red; seeds often carunculate.....11
11. Seeds finely and sharply tuberculate (North America).....8. *P. DENTATA*
11. Seeds coarsely and bluntly tuberculate (Argentina).....*P. species\**

1. *POINSETTIA PULCHERRIMA* (Willd.) Grah., Edinb. New Philos. Jour. 20:412. 1836.

*Euphorbia pulcherrima* Willd. ex Klotzsch, Allg. Gartenz. 2:27. 1834.

*Pleuradena coccinea* Raf., Atl. Jour. 1(6):182. 1833, not *Poinsettia coccinea* Dressler

*Euphorbia erythrophylla* Bertol., Nov. Comment. Acad. Scient. Inst. Bonon. 4:419, t. 41. 1840.

*Euphorbia fastuosa* Sessé & Mociño, Pl. Nov. Hisp. 81. 1888.

Distribution. The familiar cultivated poinsettia occurs as a wild plant in the rocky canyons of western Mexico, in Nayarit, Jalisco and Colima. Dr. Rzedowski suggests (personal communication) that it may also occur further south, in Michoacan and Guerrero. The habit of the plant, with a fleshy storage root especially well developed in the seedling stage, is characteristic of the tropical deciduous forest of this area.

2. *POINSETTIA RADIAN* (Benth.) Kl. & Gke., Monatsb. Akad. Berlin 1859:253. 1859.

*Euphorbia radians* Benth., Pl. Hartw. 8. 1839.

*Euphorbia stormiae* Croiz., Rev. Sudam. Bot. 6:13. 1939 [Type: *Storm s. n.* AH!].

Distribution. Arizona through central Mexico to Oaxaca.

\* Several Argentine specimens may represent an undescribed species. Some of these were determined by Croizat as *Euphorbia aureocincta* Croiz., but that epithet is irrevocably typified by a specimen of *P. heterophylla*. The plants in question are very similar to *P. dentata*, but differ somewhat in seed structure, and possibly in the proportions of the involucre. More material and study are needed to fix the status of these plants, so they shall remain nameless for the present. They are *Castellano s. n.* Dec. 5, 1927 (GH), *Castillón 1851* (GH), *Meyer 3647* (GH) and *Schreiter 10990* (AAH).

3. *POINSETTIA restiacea* (Benth.) comb. nov.*Euphorbia restiacea* Benth., Bot. Voy. Sulph. 162. 1844.

Distribution. Western Mexico (Nayarit and Durango).

Superficially the plants of *P. restiacea* resemble some species of *Agaloma*, such as *Euphorbia sphaerorbiza* Benth., because of the slender stems, narrow white bracts and conspicuous white glands. Though the outer rim of the gland is flattened and somewhat petaloid, there is no sharp distinction between gland and appendage, such as characterizes the members of *Agaloma*. The type specimen (K) is very scrappy, but a photograph (MICH) indicates that it is probably the same species as the excellent material which Dr. McVaugh has collected in Nayarit.

4. *POINSETTIA strigosa* (Hook. & Arn.) Arthur, Torreya 11:260. 1912.*Euphorbia strigosa* Hook. & Arn., Bot. Voy. Beech. 310. 1840.*Poinsettia pedunculata* Klotzsch, Seem. Bot. Voy. Herald 277. 1856.

Distribution. Western Mexico (Nayarit and Jalisco).

5. *POINSETTIA colorata* (Engelm.) comb. nov.*Euphorbia colorata* Engelm., Rep. U. S. & Mex. Bound. Surv. 2:190. 1859 [Type: *Thurber* 265, GH!].*Euphorbia tuberosa* Rose, Contr. U. S. Nat. Herb. 1:111. 1891, not *E. tuberosa* L., 1753.

Distribution. Northwestern Mexico (Sinaloa, Sonora and Zacatecas).

6. *POINSETTIA coccinea* sp. nov. Figure 2

Perennis, erecta, 40–70 cm. alta, radice tuberosa oriens, caulibus basi lignescens, glabris; folia alterna, linearia vel anguste lanceolata, 1.5–6 mm. lata, 40–120 mm. longa, subtus hispidula, ad basin barbellata, apice attenuata, basi attenuata vel breviter petiolata, marginibus serratis vel subintegris; cymarum bractearum coloratae, lineari-lanceolatae vel elliptico-lanceolatae, 3.5–7 mm. latae, 30–80 mm. longae; inflorescentiae compactae; involucri anguste campanulata, 3–3.5 mm. lata, 3.5–4 mm. longa, glandulis involucri excedentibus, 1.5–2 mm. latis, marginibus externis crassioribus altioribusque; ovarium glabrum; styli ca. 1 mm. longi, basi breve connati, fere ad medium bipartiti; semina oblongo-ovoidea, ecarunculata, tuberculata, ca. 2.5 mm. longa.

MEXICO. TAMAULIPAS, Municipio de Aldama, Sierra de Tamaulipas, above Juan Tomás, east of Rancho Las Yucas (ca. 40 km. nnw. of Aldama). Oak scrub and rocky arroyo, October 13, 1957, bracts basally red, roots with series of thickened "tubers," R. L. Dressler 2395 (Type: MO, isotypes to be distributed). Other collections from the same region are: Las Yucas, Oak scrub (chaparral), peak of Cerro de Las Yucas, July 20, 1957, rocky soil, R. L. Dressler 1930 (MO); near Paso Lajas (Ejido Las Yucas), Oak scrub, October 10, 1957, R. L. Dressler 2343 (GH). NUEVO LEÓN, Rancho Resendez, Lampazos, June 22, 1937, "Pico de perico," M. T. Edwards 313 (MO, incomplete, but apparently this species).

This species is related to *P. colorata*, but may be distinguished by the usually serrate leaves which are not markedly paler beneath and by the smaller green (rather than red) cyathia; the gland also is smaller and differently shaped. *Poinsettia coccinea* will more often be confused with the annual *P. cyathophora*. Under favorable conditions *P. cyathophora* may survive for two or more seasons, but it is



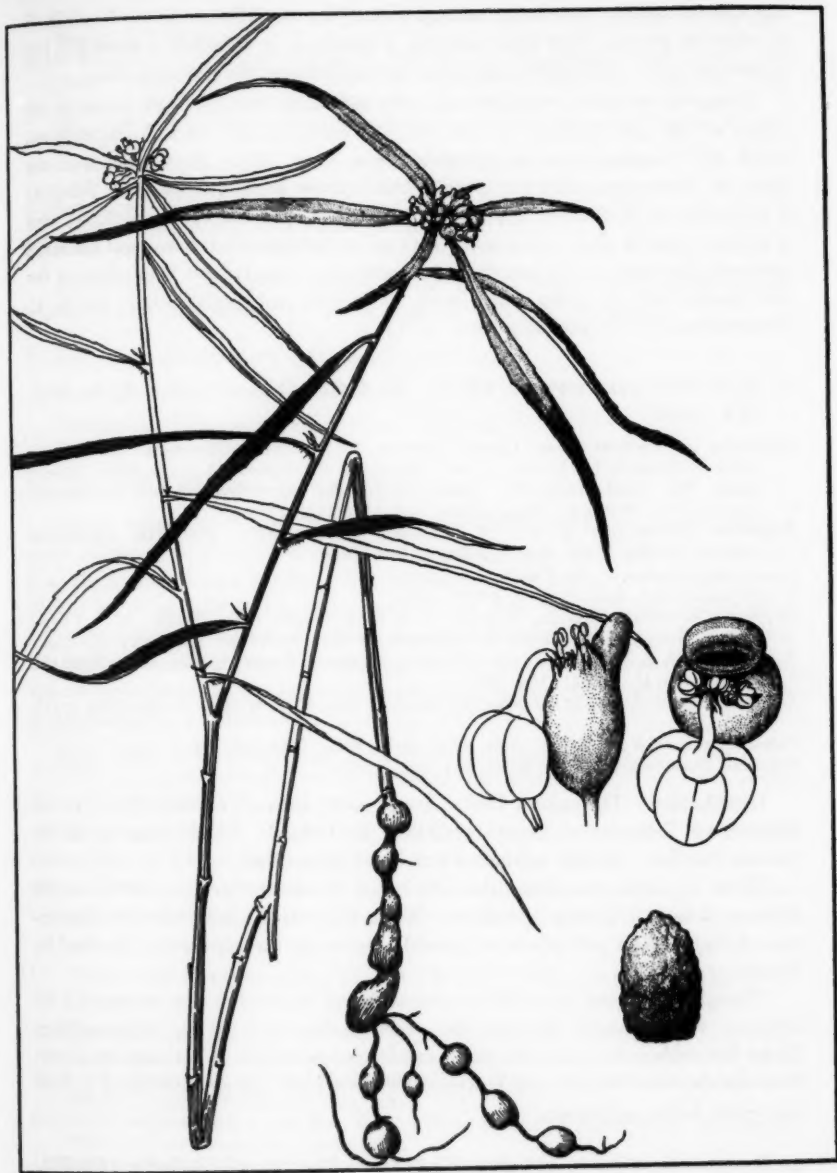


Figure 2. *Poinsettia coccinea*, drawn from living material of the type collection. Habit  $\times \frac{1}{2}$ , side view of cyathium  $\times 5$ , top view  $\times 6$ , dorsal view of seed  $\times 7.5$ .

not known to form the fleshy "sausage-string" roots of *P. coccinea*. Crutchfield & Johnston 5611A, from near Jaumave, Tamaulipas, is definitely a perennial, but appears to be *P. cyathophora* (no roots were present on the specimen seen).

*Poinsettia coccinea* is frequent in rocky oak scrub and open oak forest in the region of the type locality. In this area it is quite distinct from *P. cyathophora*, which was found only in the polyploid form ( $n = 28$ ). To the north of the Sierra de Tamaulipas other forms of *P. cyathophora* occur (Crutchfield, Johnston & McMillan 6082, Graham & Johnston 4695, both near Padilla, Tamaulipas), and it is quite possible that introgression may occur between the annual and perennial species in this region. No satisfactory chromosome counts have been obtained for this species, but the slides which were made indicated approximately 12 to 15 chromosomes, so this probably has  $n = 14$ .

7. *POINSETTIA CYATHOPHORA* (Murr.) Kl. & Gke., Monatsb. Akad. Berlin 1859: 253. 1859.

*Euphorbia cyathophora* Murr., Comm. Götting. 7:81. 1786. *Tithymalus cyathophorus* (Murr.) Moench, Meth. 667. 1794. *Euphorbia heterophylla*  $\beta$  *cyathophora* (Murr.) Boiss., DC. Prod. 15(2):72. 1862. *Euphorbia heterophylla* forma *cyathophora* (Murr.) Voss, Vilmorin, Blumengärtn. (ed. 3) 1:898. 1895.

*Euphorbia graminifolia* Michx., Fl. Bor.-Am. 2:210. 1803. *Poinsettia graminifolia* (Michx.) Millsp., Field Mus. Pub. Bot. 2:304. 1909.

*Cyathophora picta* Raf., Fl. Tell. 4:117. 1838.

*Cyathophora ciliata* Raf., Fl. Tell. 4:117. 1838.

*Euphorbia barbellata* Engelm., Rep. U. S. & Mex. Bound. Surv. 2:190. 1859 [Type: Wright s. n., GH!]. *Euphorbia heterophylla* var. *barbellata* (Engelm.) Holzinger, Contrib. U. S. Nat. Herb. 1:216. 1892. *Poinsettia barbellata* (Engelm.) Small, Fl. Southeastern U. S. 722, 1334. 1903.

*Euphorbia heterophylla* var. *graminifolia* Engelm., Rep. U. S. & Mex. Bound. Surv. 2:190. 1859.

*Poinsettia edwardsii* Kl. & Gke., Abh. Akad. Berlin Phys. 1859:104. 1860.

*Poinsettia pinetorum* Small, Fl. Miami 111, 200. 1913.

Distribution. The eastern United States south through eastern Mexico to the Isthmus of Tehuantepec; west to Colima in Mexico. Possibly native in the Greater Antilles. Widely cultivated and often naturalized.

There is a specimen from the Göttingen Botanical Garden (1794) in the Missouri Botanical Garden herbarium. While this was prepared after the description of *Euphorbia cyathophora*, it probably represents the population described by Murray.

Though this species is usually an annual, clonal material is easy to maintain by cuttings, which should facilitate the experimental study of its polymorphism. Under favorable conditions it may be a facultative perennial. I have seen specimens from northeastern Mexico and southern Florida which had over-wintered at least one season before collection.

8. *POINSETTIA DENTATA* (Michx.) Kl. & Gke., Monatsb. Akad. Berlin 1859:253. 1859.

*Euphorbia dentata* Michx., Fl. Bor.-Am. 2:211. 1803. *Anisophyllum dentatum* (Michx.) Haw., Syn. Pl. Succ. 162. 1812.

*Euphorbia herronii* Riddell, Syn. Fl. W. States 32. 1835.

*Euphorbia dentata*  $\beta$  *rigidia* Engelm., Rep. U. S. & Mex. Bound. Surv. 2:190. 1859 [Type: Wright 1837, MO!].

*Euphorbia dentata*  $\gamma$  *cuphosperma* Engelm., Rep. U. S. & Mex. Bound. Surv. 2:190. 1859 [Type: Wright 1834, MO!]. *Euphorbia cuphosperma* (Engelm.) Boiss., DC. Prod. 15(2):73. 1862. *Poinsettia cuphosperma* (Engelm.) Small, Fl. Southeastern U. S. 721, 1334. 1903. *Euphorbia dentata* forma *cuphosperma* (Engelm.) Fern., Rhodora 50:148. 1948.

*Poinsettia schiedeana* Kl. & Gke., Abh. Akad. Berlin Phys. 1859:102. 1860.

*Euphorbia dentata*  $\beta$  *lasiocarpa* Boiss., DC. Prod. 15(2):72. 1862.

*Euphorbia dentata*  $\gamma$  *linearis* Engelm. ex. Boiss., DC. Prod. 15(2):72. 1862.

*Euphorbia dentata* var. *gracillima* Millsp., Pittonia 2:90. 1890.

*Euphorbia dentata* var. *lancifolia* Farwell, Am. Midl. Nat. 8:273. 1923.

Distribution. The eastern United States west to Arizona and south through Mexico possibly to Guatemala. To be expected as a weed elsewhere.

#### 9. POINSETTIA *pentadactyla* (Griseb.) comb. nov.

*Euphorbia pentadactyla* Griseb., Gött. Abh. 24:63. 1879.

Distribution. Paraguay and northern Argentina.

#### 10. POINSETTIA *inornata* sp. nov. Figure 3

Annual, ramosa, 8–14 cm. alta, ramisque procumbens ad 12 cm. longa, caulibus sparse pilosis; folia alterna vel ea basalia opposita, ovata vel elliptica, 8–16 mm. lata, 12–32 mm. longa, subtus sparse hispidula, apice acuta, basi cuneata, marginibus leviter serratis et hispidulis, petiolis 2–6 mm. longis; cymae dichotomae, involucris late campanulatis, ca. 2 mm. longis, 1.2–2 mm. latis, glandulis 0.6–0.8 mm. latis, ostio oblongo; ovarium glabrum styli ca. 1 mm. longi, basi breve connati, fere ad basin bipartiti; semina quadrato-ovoidea, minute carunculata, sub-laevia, paucituberculata, 2.5 mm. longa.

PERU. Dept. & Prov. Lima, Dist. Pachacamac; Atacongo; among rocks in arid valley, alt. 195 m., common, scattered, October 14, 1935, Ynes Mexia 04044 (Type: MO, isotype GH, presumably also at UC).

This is apparently a deep-rooted, spreading annual. The plant would pass superficially for a small delicate *P. heterophylla*, but the gland is quite different in shape, and the nearly smooth seed with an equatorial row of small, blunt tubercles, and fainter basal and distal rows, is unlike that of any other species of *Poinsettia*.

#### 11. POINSETTIA *HETEROPHYLLA* (L.) Kl. & Gke., Monatsb. Akad. Berlin 1859: 253. 1859.

*Euphorbia heterophylla* L., Sp. Pl. 453. 1753. *Tithymalus heterophyllus* (L.) Haw., Syn. Pl. Succ. 141. 1812. *Cyathophora heterophylla* (L.) Raf., Fl. Tell. 4:117. 1838.

?*Euphorbia elliptica* Lam., Encyc. Meth. Bot. 2:425. 1788. *Euphorbia heterophylla* var. *elliptica* (Lam.) O. Ktze., Rev. Gen. 2:605. 1891.

?*Euphorbia linifolia* Vahl, Symb. Bot. 2:53. 1791. *Euphorbia heterophylla* var. *linifolia* (Vahl) O. Ktze., Rev. Gen. 2:605. 1891.

*Euphorbia geniculata* Ortega, Hort. Mat. Dec. 18. 1797. *Poinsettia geniculata* (Ort.) Kl. & Gke., Monatsb. Akad. Berlin 1859:253. 1859. *Euphorbia heterophylla*  $\epsilon$  *geniculata* (Ort.) Gómez, Anal. Hist. Nat. Madrid 23:46. 1894.

*Euphorbia prunifolia* Jacq., Hort. Schoenb. 3:15, t. 277. 1798. *Tithymalus prunifolius* (Jacq.) Haw., Syn. Pl. Succ. 143. 1812. *Poinsettia prunifolia* (Jacq.) Kl. & Gke., Monatsb. Akad. Berlin 1859:253. 1859.

- Euphorbia frangulaefolia* HBK., Nov. Gen. et Sp. 2:62. 1817. *Poinsettia frangulaefolia* (HBK.) Kl. & Gke., Monatsb. Akad. Berlin 1859:253. 1859.  
*Euphorbia trachyphylla* A. Rich., La Sagra, Hist. Cuba 9:198. 1850.  
*Euphorbia morisoniana* Kl., Seem. Bot. Voy. Herald 100. 1853. *Poinsettia morisoniana* (Kl.) Kl. & Gke., Monatsb. Akad. Berlin 1859:253. 1859.  
*Poinsettia ruiziana* Kl. & Gke., Abh. Akad. Berlin Phys. 1859:102. 1860.  
 ?*Euphorbia heterophylla*  $\delta$  minor Boiss., DC. Prod. 15(2):73. 1862.  
*Euphorbia heterophylla* var. *brasiliensis* Müll. Arg., Mart. Fl. Bras. 11(2):695. 1874.  
*Euphorbia prunifolia* var.  $\alpha$  *repanda* Müll. Arg., Mart. Fl. Bras. 11(2):694. 1874.  
*Euphorbia prunifolia* var.  $\gamma$  *angustifolia* Müll. Arg., Mart. Fl. Bras. 11(2):695. 1874.  
*Euphorbia zonosperma* Müll. Arg., Mart. Fl. Bras. 11(2):696. 1874.  
*Euphorbia heterophylla*  $\beta$  *elliptica* forma *hirticaulis* O. Ktze., Rev. Gen. 3(2):286. 1898.  
*Poinsettia bavanensis* Small, Fl. Southeastern U. S. 722, 1334. 1903.  
*Euphorbia aureocincta* Croiz., Jour. Arnold Arb. 24:181. 1943 [Type: Rojas 3379, AH!].

Distribution. From Arizona and Tamaulipas southward throughout the American tropics. As a weed throughout the tropics. Naturalized in Louisiana and Texas and to be expected elsewhere.

#### EXCLUDED SPECIES

- Poinsettia eriantha* (Benth.) Rose & Standley, Contrib. U. S. Nat. Herb. 16:13. 1912. = *Euphorbia* (*Agaloma*) *eriantha* Benth. This species, *E. (A.) extipulata* Engelm., *E. (A.) jaliscensis* Rob. & Greenm., and *E. (A.) lacera* Boiss. are all closely related. All of these species have small but distinct petaloid appendages on the glands and have seeds which are unlike those of *Poinsettia*. In *E. (A.) eriantha*, at least, the pollen grains are very unlike those of *Poinsettia*.  
*Euphorbia heterophylla* var. *eriocarpa* Millsp., Proc. Cal. Acad. II 2:230. 1889. The type (F!) is not a *Poinsettia*, but appears to be an *Agaloma* with reduced gland appendages, or possibly a *Tithymalus*. It is probably unnamed as a species.  
*Poinsettia insulana* (Vell.) Kl. & Gke., Monatsb. Akad. Berlin 1859:253. 1859. = *Euphorbia* (*Agaloma*) *insulana* Vell. This and the following two species are closely related, if not conspecific.  
*Poinsettia lancifolia* (Schlecht.) Kl. & Gke., Monatsb. Akad. Berlin 1859:253. 1859. = *Euphorbia* (*Agaloma*) *lancifolia* (Schlecht.)  
*Poinsettia oerstediana* Kl. & Gke., Abh. Akad. Berlin Phys. 1859:103. 1860. = *Euphorbia* (*Agaloma*) *oerstediana* (Kl. & Gke.) Boiss.  
*Poinsettia punicea* (Sw.) Kl. & Gke., Monatsb. Akad. Berlin 1859:253. 1859. = *Tithymalus puniceus* (Sw.) Haw.  
*Poinsettia xalapensis* (HBK.) Kl. & Gke., Monatsb. Akad. Berlin 1859:253. 1859. = *Euphorbia* (*Agaloma*) *xalapensis* HBK.

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 Plukenet, L. 1696. *Almagestum Botanicum*. London, 402 pp.  
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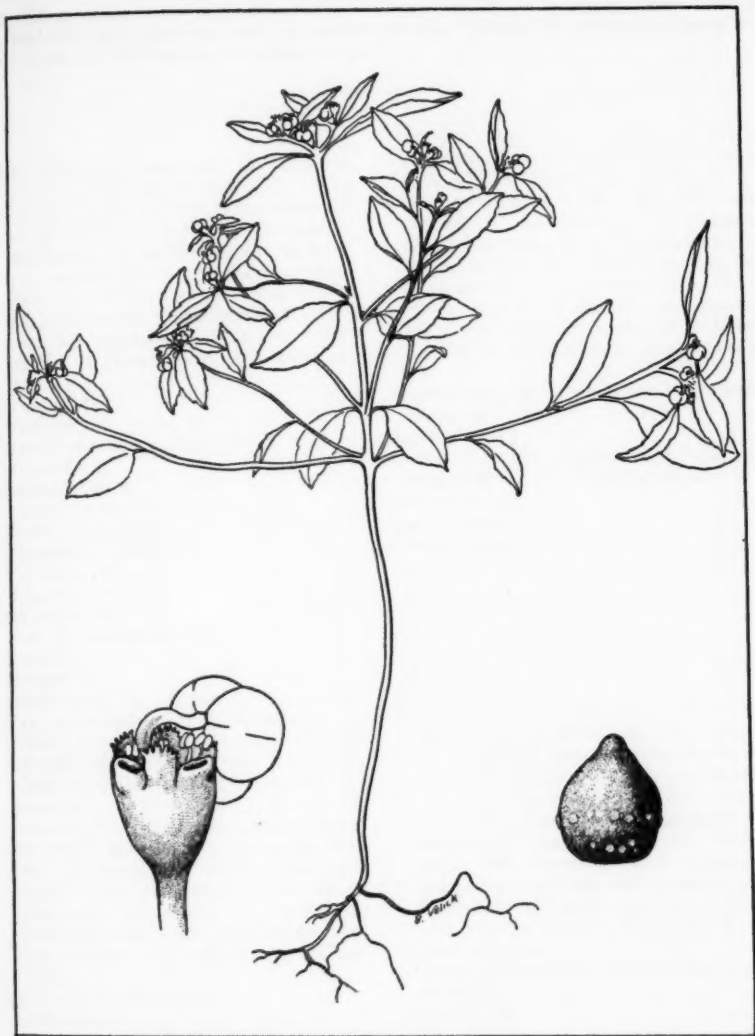


Figure 3. *Poinsettia inornata*, drawn from the type specimen. Habit  $\times \frac{1}{16}$ , cyathium  $\times 10$ , dorsal view of seed  $\times 8$ .





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